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(54) Title: EPITOPE REGIONS OF A THYROTROPHIN (TSH) RECEPTOR, USES THEREOF AND ANTIBODIES THERETO

(57) Abstract: The present invention is concerned with epitope regions of a thyrotrophin (TSH) receptor, uses thereof and antibodies thereto.

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Epitope Regions of a Thyrotrophin (TSH) Receptor,**Uses thereof and Antibodies thereto**

The present invention is concerned with epitope regions of a thyrotrophin (TSH) receptor,
5 uses thereof and antibodies thereto.

Thyrotrophin or thyroid stimulating hormone (TSH) is a pituitary hormone which plays
a key role in regulating the function of the thyroid. Its release is stimulated by the
hormone TRH formed in the hypothalamus and controls the formation and release of the
10 important thyroid hormones thyroxine (T4) and tri-iodothyronine (T3). On the basis of
a feedback mechanism, the thyroid hormone content of the serum controls the release of
TSH. The formation of T3 and T4 by the thyroid cells is stimulated by TSH by a
procedure in which the TSH released by the pituitary binds to the TSH receptor of the
thyroid cell membrane.

15 In certain pathological conditions, various types of autoantibodies against this TSH
receptor can also be formed. Depending on the type of these autoantibodies, either
inhibition of the formation and release of T3 and T4 may occur at the TSH receptor owing
to the shielding of the TSH molecules, or, on the other hand, these thyroid hormones may
20 be released in an uncontrolled manner because the anti-TSH receptor autoantibodies
mimic the action of the TSH and stimulate the synthesis and release of thyroid hormones.

Autoimmune thyroid disease (AITD) is the most common autoimmune disease affecting
different populations worldwide. A proportion of patients with AITD, principally those
25 with Graves' disease, have autoantibodies to the TSH receptor substantially as
hereinbefore described. The autoantibodies bind to the TSH receptor and usually mimic
the actions of TSH, stimulating the thyroid gland to produce high levels of thyroid
hormones. These autoantibodies are described as having stimulating activity. In some
patients, autoantibodies bind to the TSH receptor but do not stimulate thyroid hormone
30 production and are described as having blocking activity [J Sanders, Y Oda, S-A Roberts,
M Maruyama, J Furmaniak, B Rees Smith "Understanding the thyrotrophin receptor

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function-structure relationship." Baillière's Clinical Endocrinology and Metabolism. Ed. T F Davies 1997 11(3): 451-479. Pub. Baillière Tindall, London].

Measurements of TSH receptor autoantibodies are important in the diagnosis and management of AITD, particularly Graves' disease. Currently three types of assays are used to measure TSH receptor autoantibodies:

- (a) competitive binding assays which measure the ability of TSH receptor autoantibodies to inhibit the binding of TSH to preparations of TSH receptor;
- (b) bioassays which measure the ability of TSH receptor autoantibodies to stimulate cells expressing the TSH receptor in culture; and
- (c) immunoprecipitation of TSH receptor preparations with TSH receptor autoantibodies.

Measurement of TSH receptor autoantibodies using such assays are described in references J Sanders, Y Oda, S-A Roberts, M Maruyama, J Furmaniak, B Rees Smith "Understanding the thyrotrophin receptor function-structure relationship." Baillière's Clinical Endocrinology and Metabolism. Ed. T F Davies 1997 11(3): 451-479. Pub. Baillière Tindall, London, and J Sanders, Y Oda, S Roberts, A Kiddie, T Richards, J Bolton, V McGrath, S Walters, D Jaskólski, J Furmaniak, B Rees Smith "The interaction of TSH receptor autoantibodies with ¹²⁵I-labelled TSH receptor." Journal of Clinical Endocrinology and Metabolism 1999 84(10):3797-3802.

There are, however, a number of limitations associated with the use of the above described currently available assays for measuring TSH receptor autoantibodies. The competitive assays of type (a) which are available in different formats are generally sensitive, relatively easy to perform and adaptable for routine use. However, competitive radioreceptor assays known to date for detecting TSH receptor autoantibodies have

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fundamental disadvantages of a practical nature which can be ascribed to the fact that the binding ability of TSH receptor preparations generally react very sensitively to changes in the receptor or in a biomolecule bound by it. The binding of biomolecules which are peptides or protein in nature, for example hormones or autoantibodies, to receptors is as a rule very complicated in nature, and the specific binding between receptor and biomolecule is very much more sensitive to structural alterations, in particular of the receptor, than is the case with a usual antigen/antibody binding pair which is the basis of most immunoassays in which receptors are involved. Attempts to immobilise and / or to label the TSH receptor have as a rule led to structural alterations which have greatly impaired the functionality of the receptor.

As far as bioassays of the type mentioned in (b) are concerned, these tend to be expensive, time-consuming, require highly skilled staff and are essentially unsuitable for routine use.

With respect to the direct immunoprecipitation assays of type (c), currently available such immunoprecipitation assays do not in practice have the required sensitivity for TSH receptor autoantibody detection.

The present invention alleviates the problems hitherto associated with the prior art detection of TSH receptor autoantibodies. More particularly, the present invention provides diagnostic methods and kits for screening for TSH receptor autoantibodies, with improved sensitivity compared to prior art diagnostic methods and kits, and which, if desired, allow the use of one or more competitive binding partners or competitors for a TSH receptor in competitive assays of the type described above. In particular the present invention is concerned with the use of one or more identified epitope regions of TSH receptor in diagnostic methods and kits for screening for TSH receptor autoantibodies.

There is provided by the present invention, therefore, for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence comprising part or all of the primary structural conformation (that is a continuous sequence of amino acid residues) of one or more TSH receptor epitopes with

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which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

(in particular said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and / or the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments);

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) with said polypeptide sequence, so as to enable said diagnosis or therapy.

More particularly, there is provided by the present invention for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide

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sequence comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

5 amino acid numbers 22 to 91 of a TSH receptor;
 amino acid numbers 246 to 260 of a TSH receptor;
 amino acid numbers 260 to 363 of a TSH receptor; and
 amino acid numbers 380 to 418 of a TSH receptor;

10 (in particular said polypeptide sequence comprising, consisting of or consisting essentially
of the primary structural conformation of amino acid numbers 277 to 296 of a TSH
receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers
277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and
/ or the primary structural conformation of amino acid numbers 246 to 260 of a TSH
15 receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers
246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments);

wherein autoantibodies produced in response to a TSH receptor interact (suitably under
conditions that allow interaction of a TSH receptor with such autoantibodies) with said
20 polypeptide sequence, so as to enable said diagnosis or therapy.

Alternatively, there is provided by the present invention for use in diagnosis or therapy
of autoimmune disease associated with an immune reaction to a TSH receptor, a
polypeptide sequence comprising, consisting of or consisting essentially of part or all of
25 the primary structural conformation of one or more TSH receptor epitopes with which
lymphocytes produced in response to a TSH receptor interact (suitably under conditions
that allow interaction of a TSH receptor with such lymphocytes), said polypeptide
sequence comprising, consisting of or consisting essentially of the primary structural
conformation of one or more of the following, or one or more variants, analogs,
30 derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

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amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

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(in particular said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and
10 / or the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments);

wherein lymphocytes produced in response to a TSH receptor interact (suitably under
15 conditions that allow interaction of a TSH receptor with such lymphocytes) with said polypeptide sequence, so as to enable said diagnosis or therapy.

The present invention further provides for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence
20 comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary
25 structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
30 amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

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as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more
5 variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and / or the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of
10 amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments);

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such
15 autoantibodies or lymphocytes) with said polypeptide sequence, so as to enable said diagnosis or therapy.

More particularly, the present invention further provides for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a
20 polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural
25 conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;

amino acid numbers 246 to 260 of a TSH receptor;

30 amino acid numbers 260 to 363 of a TSH receptor; and

amino acid numbers 380 to 418 of a TSH receptor;

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as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and / or the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments);

wherein autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) with said polypeptide sequence, so as to enable said diagnosis or therapy.

The present invention further provides for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

- amino acid numbers 22 to 91 of a TSH receptor;
- amino acid numbers 246 to 260 of a TSH receptor;
- amino acid numbers 260 to 363 of a TSH receptor; and
- amino acid numbers 380 to 418 of a TSH receptor;

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as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more
5 variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and / or the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of
10 amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments);

wherein lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) with said
15 polypeptide sequence, so as to enable said diagnosis or therapy.

More preferably, it is generally preferred that such diagnostic or therapeutic use employs a polypeptide sequence or sequences comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more
20 variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;
amino acid numbers 36 to 42 of a TSH receptor;
25 amino acid numbers 247 to 260 of a TSH receptor;
amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor;

(in particular said polypeptide sequence comprising, consisting of or consisting essentially
30 of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers

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277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and / or the primary structural conformation of amino acid numbers 247 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 247 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments).

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In particular, it is generally preferred according to the present invention that such diagnostic or therapeutic use employs amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

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In particular, it is generally preferred according to the present invention that such diagnostic or therapeutic use employs amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

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In particular, it is generally preferred according to the present invention that such diagnostic or therapeutic use employs amino acid numbers 247 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

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A particularly preferred such diagnostic or therapeutic use according to the present invention, comprises for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor:

25

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more

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variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments;

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) with said polypeptide sequences, so as to enable said diagnosis or therapy.

More particularly, such diagnostic or therapeutic use may comprise:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and

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(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments;

wherein autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) with said polypeptide sequences, so as to enable said diagnosis or therapy.

Alternatively, such diagnostic or therapeutic use may comprise:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said polypeptide sequence comprising, consisting of or

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consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments;

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wherein lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) with said polypeptide sequences, so as to enable said diagnosis or therapy.

1.0 A particularly preferred diagnostic or therapeutic use according to the present invention, comprises for use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor:

1.5 (i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural
2.0 conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and

2.5

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow
3.0 interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the

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primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments;

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) with said polypeptide sequences, so as to enable said diagnosis or therapy.

More particularly, such diagnostic or therapeutic use may comprise:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of

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amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments;

wherein autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) with said polypeptide sequences, so as to enable said diagnosis or therapy.

Alternatively, such diagnostic or therapeutic use may comprise:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments

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of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments;

5 wherein lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) with said polypeptide sequences, so as to enable said diagnosis or therapy.

10 It may also be further preferred that the above mentioned diagnostic or therapeutic use employing:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments;

further employs:

(iii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor, or variants, analogs or derivatives of such fragments.

More particularly, such preferred diagnostic or therapeutic use employs:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments;

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow

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interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments; and

(iii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or variants, analogs or derivatives of such fragments.

As will be appreciated from the accompanying Figures, the above mentioned amino acid sequences can be of human, porcine, bovine, canine, feline, mouse, rat or ovine origin, and the specific amino acid sequences in each of the above mentioned species are hereinafter described in greater detail with reference to Figures 1, 3, 5, and 7.

There also provided by the present invention one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of

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such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
5 amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor,
10 or variants, analogs or derivatives of such fragments; or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments).

15 More particularly, there is provided by the present invention one or more TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), said one or more TSH receptor epitopes comprising, consisting of or
20 consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
25 amino acid numbers 380 to 418 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor,
30 or variants, analogs or derivatives of such fragments; or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such

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fragments).

Alternatively, there is provided by the present invention one or more TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

10 amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

15 (in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments).

The present invention further provides one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

30 amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;

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amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in
particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the
amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or
fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of
the amino acid sequences of Figure 5, or variants, analogs or derivatives of such
fragments; or amino acid numbers 246 to 260 of a TSH receptor as depicted in any one
of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or
fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of
the amino acid sequences of Figure 3, or variants, analogs or derivatives of such
fragments).

More particularly, the present invention further provides one or more TSH receptor
epitopes with which autoantibodies produced in response to a TSH receptor interact
(suitably under conditions that allow interaction of a TSH receptor with such
autoantibodies), said one or more TSH receptor epitopes comprising, consisting of or
consisting essentially of one or more of the following, or one or more variants, analogs,
derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in
particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the
amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or
fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of
the amino acid sequences of Figure 5, or variants, analogs or derivatives of such

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fragments; or amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments).

The present invention further provides one or more TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), said TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; or amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments).

More preferably, it is generally preferred that one or more TSH receptor epitopes comprise one or more of the following, or one or more variants, analogs, derivatives or fragments

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thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;
amino acid numbers 36 to 42 of a TSH receptor;
5 amino acid numbers 247 to 260 of a TSH receptor;
amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants,
10 analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor,
or variants, analogs or derivatives of such fragments; or amino acid numbers 247 to 260
of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino
acid numbers 247 to 260 of a TSH receptor, or variants, analogs or derivatives of such
fragments).

15 A particularly preferred TSH receptor epitope according to the present invention
comprises, consists of or consists essentially of amino acid numbers 277 to 296 of a TSH
receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants,
analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes
20 produced in response to a TSH receptor can interact (suitably under conditions that allow
interaction of a TSH receptor with such autoantibodies or lymphocytes).

A particularly preferred TSH receptor epitope according to the present invention
comprises, consists of or consists essentially of amino acid numbers 246 to 260 of a TSH
25 receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants,
analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes
produced in response to a TSH receptor can interact (suitably under conditions that allow
interaction of a TSH receptor with such autoantibodies or lymphocytes).

30 A particularly preferred TSH receptor epitope according to the present invention
comprises, consists of or consists essentially of amino acid numbers 247 to 260 of a TSH

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receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes).

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There is also provided by the present invention a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises, consists of or consists essentially of part or all of the
10 primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one
15 or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
20 amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor,
25 or variants, analogs or derivatives of such fragments; and / or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments), with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH
30 receptor with such autoantibodies or lymphocytes), with the exception of a full length TSH receptor.

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More particularly, there is provided by the present invention a polypeptide with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) and which comprises, consists of or consists essentially of part or all of the primary structural conformation (that is a continuous sequence of amino acid residues) of one or more epitopes of a TSH receptor with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;

amino acid numbers 246 to 260 of a TSH receptor;

amino acid numbers 260 to 363 of a TSH receptor; and

amino acid numbers 380 to 418 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and / or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments), with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), with the exception of a full length TSH receptor.

Alternatively, there is provided by the present invention a polypeptide with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) and which comprises, consists of or consists essentially of part or all of the primary structural conformation (that is a continuous sequence of amino acid residues) of one or more

epitopes of a TSH receptor with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

(in particular amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and / or amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments), with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), with the exception of a full length TSH receptor.

The present invention further provides a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or

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derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;

amino acid numbers 246 to 260 of a TSH receptor;

5 amino acid numbers 260 to 363 of a TSH receptor; and

amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or
10 fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and / or amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives
15 or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments), with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), with the exception of a full length
20 TSH receptor.

More particularly, the present invention further provides a polypeptide with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) and which
25 comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more
30 of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

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amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

5

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such
10 fragments; and / or amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such
15 fragments), with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), with the exception of a full length TSH receptor.

20

The present invention further provides a polypeptide with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such
25 lymphocytes), which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

30

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;

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amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

5 as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, (in particular amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and / or amino acid numbers 246 to 260 of a TSH receptor as depicted in any
10 one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments), with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such
15 lymphocytes), with the exception of a full length TSH receptor.

More preferably, it is generally preferred that a polypeptide according to the present invention can comprise part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in
20 response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and as such comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or
25 lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes):

amino acid numbers 32 to 41 of a TSH receptor;
30 amino acid numbers 36 to 42 of a TSH receptor;
amino acid numbers 247 to 260 of a TSH receptor;

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amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor.

5 Preferably a polypeptide according to the present invention comprises, consists of or consists essentially of, amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

10 Preferably a polypeptide according to the present invention comprises, consists of or consists essentially of, amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

15 Preferably a polypeptide according to the present invention comprises, consists of or consists essentially of, amino acid numbers 247 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

20 It is also preferred according to the present invention that there is provided a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow
25 interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of:

30 (i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in

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response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes); and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

with the exception of a full length TSH receptor.

More particularly, there is provided by the present invention a polypeptide with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), which polypeptide comprises, consists of or consists essentially of:

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies); and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies produced in response to a TSH

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receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies);

with the exception of a full length TSH receptor.

5

Alternatively, there is provided by the present invention a polypeptide with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with
10 which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), which polypeptide comprises, consists of or consists essentially of:

15

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes); and

20

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which lymphocytes produced in response to a TSH receptor
25 can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes);

with the exception of a full length TSH receptor.

30

The present invention further provides a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under

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conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises part or all of the primary structural conformation of epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of:

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes); and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

with the exception of a full length TSH receptor.

More particularly, the present invention further provides a polypeptide with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with

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which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies), which polypeptide comprises, consists of or consists essentially of:

5 (i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments, with which
10 autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies); and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or
15 one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments, with which autoantibodies produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies);

20 with the exception of a full length TSH receptor.

The present invention further provides a polypeptide with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction
25 of a TSH receptor with such lymphocytes) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes), which polypeptide comprises, consists of or consists essentially of:

30 (i) the primary structural conformation of amino acid numbers 277 to 296 of a

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TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments, with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes); and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments, with which lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such lymphocytes);

with the exception of a full length TSH receptor.

It is also preferred according to the present invention that there is provided a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises part or all of the primary structural conformation of TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of:

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow

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interaction of a TSH receptor with such autoantibodies or lymphocytes);

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes); and

(iii) the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

with the exception of a full length TSH receptor.

More particularly, the present invention further provides a polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes) and which comprises part or all of the primary structural conformation of epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes), which polypeptide comprises, consists of or consists essentially of:

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of

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Figure 5, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

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(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

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(iii) the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact (suitably under conditions that allow interaction of a TSH receptor with such autoantibodies or lymphocytes);

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with the exception of a full length TSH receptor.

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As will be appreciated from the accompanying Figures, such amino acid sequences can be of human, porcine, bovine, canine, feline, mouse, rat or ovine origin, and the specific amino acid sequences in each of the above mentioned species are hereinafter described in greater detail with reference to Figures 1, 3, 5, and 7. Suitably, in the case where polypeptides according to the second aspect of the present invention comprise amino acid sequences corresponding to part or all of the primary structural conformation of more than

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one epitope of a TSH receptor, the respective amino acid sequences corresponding to part or all of the primary structural conformation of respective epitopes may be separated by linker amino acid sequences so as to preferably provide the respective amino acid sequences in a conformation, arrangement or sequence that resembles or substantially resembles a conformation, arrangement or sequence of amino acids as present in an active site of a TSH receptor, and / or can be effective in providing the above referred to respective amino acid sequences of a TSH receptor in a conformation, arrangement or sequence optimal for interaction with autoantibodies and / or lymphocytes as described herein.

Preferred polypeptide sequences and polypeptides according to the present invention comprise, consist of, or consist essentially of, the specifically referred to amino acid numbered sequences of a TSH receptor as respectively shown in any of accompanying Figures 1, 3, 5 or 7. As indicated above, however, the present invention also covers "variants", "analogs", "derivatives" and "fragments" of specific amino acid sequences described herein and the terms "variants", "analogs", "derivatives" and "fragments" as used herein when referring to polypeptide sequences and polypeptides according to the present invention (such as polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures) can be characterised as polypeptide sequences and polypeptides which retain essentially the same biological function or activity (in terms of autoantibody and / or lymphocyte interaction as described herein) as polypeptide sequences and polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures. Suitably, variants, analogs, derivatives and fragments, or variants, analogs or derivatives of the fragments as described herein can have a primary structural conformation of amino acids as seen in the accompanying Figures in which several or a few (such as 5 to 10, 1 to 5 or 1 to 3) amino acid residues are substituted, deleted or added, in any combination. Especially preferred among these are silent substitutions, additions or deletions which do not alter or substantially alter the biological activity or function of polypeptides according to the present invention as specifically described above. Conservative substitutions can be preferred as hereinafter

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described in greater detail.

More particularly, variants, analogs or derivatives of polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures may be:

(i) ones in which one or more of the amino acid residues are substituted with a conserved or non-conserved amino acid residue (preferably a conserved amino acid residue); or

(ii) ones in which one or more of the amino acid residues includes a substituent group; or

(iii) ones which further comprise additional amino acids that can be effective in providing the above referred to amino acid numbers of a TSH receptor that are present in a polypeptide of the present invention in a conformation, arrangement or sequence that resembles or substantially resembles a conformation, arrangement or sequence of amino acids as present in an active site of a TSH receptor, and / or can be effective in providing the above referred to amino acid numbers of a TSH receptor that are present in a polypeptide of the present invention in a conformation, arrangement or sequence optimal for interaction with autoantibodies and / or lymphocytes as described herein.

Such variants, derivatives and analogs are deemed to be within the scope of those skilled in the art from the teachings herein.

Typically, variants, analogs or derivatives can be those that vary from a reference (such as polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures) by conservative amino acid substitutions. Such substitutions are those that substitute a given amino acid in a

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polypeptide by another amino acid of like characteristics. Typically seen as conservative substitutions are the replacements, one for another, among the aliphatic amino acids A, V, L and I; among the hydroxyl residues S and T; among the acidic residues D and E; among the amide residues N and Q; among the basic residues K and R; and among the aromatic residues F and Y.

It may be preferred that variants, analogs or derivatives as provided by the present invention are ones which further comprise additional amino acids that can be effective in providing the above referred to amino acid numbers of a TSH receptor that are present in a polypeptide of the present invention in a conformation, arrangement or sequence that resembles or substantially resembles a conformation, arrangement or sequence of amino acids as present in an active site of a TSH receptor, and / or can be effective in providing the above referred to amino acid numbers of a TSH receptor that are present in a polypeptide of the present invention in a conformation, arrangement or sequence optimal for interaction with autoantibodies and / or lymphocytes as described herein.

More particularly, the term "fragment" as used herein denotes a polypeptide having an amino acid sequence that entirely is the same as part but not all of the amino acid sequence of a polypeptide having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures, and variants or derivatives thereof and such fragments may be "free standing", i.e. not part of or fused to other amino acids or polypeptides, or they may be comprised within a larger polypeptide of which they form a part or region. As will be appreciated, fragments according to the present invention comprise or contain the primary structural conformation of amino acids present in one or more epitopes of a TSH receptor as described herein so as to be capable of interaction with autoantibodies and / or lymphocytes as described herein.

Polypeptides of the present invention, therefore, include polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures as well as polypeptides (namely variants, analogs and derivatives as referred to above) having at least 70% identity to polypeptides having a primary

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structural conformation of specified amino acids as described herein with reference to the accompanying Figures, preferably at least 80% identity to the polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures, and more preferably at least 90% identity to polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures and still more preferably at least 95% identity to polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures and also includes fragments of such polypeptides substantially as referred to above.

A polypeptide according to the present invention is suitably obtained by, or is obtainable by, expression of a polynucleotide according to the present invention substantially as hereinafter described. Alternatively, the polypeptides of the invention can be synthetically produced by conventional peptide synthesisers employing techniques which are well known in the art. A polypeptide according to the present invention so obtained can be advantageous in being free from association with other eukaryotic polypeptides or contaminants which might otherwise be associated therewith in its natural environment.

Polypeptides according to the present invention substantially as herein described can be expressed in various systems generating recombinant proteins. For example, for expression in *E coli*, cDNA coding for the appropriate polypeptides according to the present invention can be cloned into a vector, such as pET22, pMEX8, pGEX2T or pQE-81L His or an equivalent. In the case of expression in yeast (for example *Saccharomyces cerevisiae* or *Schizosaccharomyces pombe*), vectors such as pYES2, pESP2 or pYES2/CT or an equivalent, can be employed. AcMNPV (Bac-N-Blue) vector or an equivalent can be used for expression in insect cells and pRC/CMV, pcDNA3.1 vectors or an equivalent can be used for expression in mammalian cells, such as Chinese Hamster Ovary (CHO) cells. A polypeptide according to the present invention can be expressed as a discrete protein, or as a fusion protein linked to, for example, glutathione S transferase (GST) or poly histidine linker. For a discrete protein, affinity column chromatography purification using a mouse monoclonal antibody to the relevant part of a polypeptide according to the

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present invention coupled to a Sepharose particle can be used. If a polypeptide according to the present invention is fused to GST, glutathione Sepharose chromatography purification can be used to isolate the fusion protein. Specific proteases can be used to separate GST from a polypeptide according to the present invention and a second round of glutathione Sepharose chromatography can be used to separate GST from a polypeptide according to the present invention. In the case of peptides linked to poly histidine linker, the purification can be carried out using immobilised metal affinity chromatography.

The present invention further provides a process of preparing a polypeptide substantially as hereinbefore described, which process comprises:

- (i) providing a host cell substantially as hereinbefore described;
- (ii) growing the host cell; and
- (iii) recovering a polypeptide according to the present invention therefrom.

Recovery of a polypeptide according to the present invention can typically employ conventional isolation and purification techniques, such as chromatographic separations or immunological separations, known to one of ordinary skill in the art.

In accordance with a further aspect of the present invention, there is provided a polynucleotide comprising:

- (i) a nucleotide sequence encoding a polypeptide substantially as hereinbefore described;
- (ii) a nucleotide sequence encoding a polypeptide substantially as hereinbefore described, which polypeptide comprises an amino acid sequence or sequences of specified amino acid numbers of a TSH receptor which is or are defined by reference to any of Figures 1, 3, 5 and 7;

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(iii) a nucleotide sequence encoding a polypeptide of (ii), which nucleotide sequence comprises nucleotide bases encoding the above mentioned specified amino acid numbers of a TSH receptor which are defined by reference to any of Figures 1, 3, 5, and 7, and which nucleotide bases are defined by reference to any of Figures 2, 4, 6 and 8;

(iv) a nucleotide sequence differing from the sequence of (iii) in codon sequence due to the degeneracy of the genetic code;

(v) a nucleotide sequence comprising an allelic variation of the sequence of (iii);

(vi) a nucleotide sequence comprising a fragment of any of the sequences of (i), (ii), (iii), (iv) or (v); or

(vii) a nucleotide sequence which hybridizes under stringent conditions to any of the sequences of (i), (ii), (iii), (iv), (v) or (vi).

The nucleotide bases of a polynucleotide according to the present invention, encoding the above mentioned epitope regions of a polypeptide according to the present invention, can be summarised as follows.

Amino Acid Numbers	Nucleotide Numbers
22-91	64-273
32-41	94-123
36-42	106-126
246-260	736-780
247-260	739-780
260-363	778-1089
277-296	829-888

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380-418	1138-1254
381-385	1141-1155

Polynucleotides of the present invention may be in the form of DNA, including, for instance, cDNA, synthetic DNA and genomic DNA appropriately obtained by cloning or produced by chemical synthetic techniques or by a combination thereof. A preferred embodiment of the present invention preferably comprises cDNA or synthetic DNA.

The coding sequence which encodes a polypeptide according to the present invention may be identical to the coding sequence of a polynucleotide as referred to above in (iii) and defined by reference to any of Figures 2, 4, 6 and 8. It also may be a polynucleotide with a different sequence, which, as a result of the redundancy (degeneracy) of the genetic code, encodes a polypeptide according to the present invention.

The present invention further relates to variants of the herein above described polynucleotides which encode for polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures, variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of the fragments and substantially as hereinbefore described in greater detail. A variant of the polynucleotide may be a naturally occurring variant such as a naturally occurring allelic variant, or it may be a variant that is not known to occur naturally. Such non-naturally occurring variants of the polynucleotide may be made by mutagenesis techniques.

Among the variants in this regard are variants that differ from the aforementioned polynucleotides by nucleotide substitutions, deletions or additions. The substitutions, deletions or additions may involve one or more nucleotides. Alterations in the coding regions may produce conservative or non-conservative amino acid substitutions, deletions or additions, again substantially as hereinbefore described.

Variant polynucleotides according to the present invention are suitably at least 70%

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identical over their entire length to a polynucleotide encoding polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures, and polynucleotides which are complementary to, or hybridise to, such polynucleotides. Alternatively, most highly preferred are polynucleotides that comprise a region that is at least 80% identical over its entire length to a polynucleotide encoding a polypeptides having a primary structural conformation of specified amino acids as described herein with reference to the accompanying Figures and polynucleotides which are complementary to, or hybridise to, such polynucleotides. In this regard, polynucleotides at least 90% identical over their entire length to the same are particularly preferred, and among these particularly preferred polynucleotides, those with at least 95% identity are especially preferred. Furthermore, those with at least 97% identity are highly preferred among those with at least 95% identity, and among these those with at least 98% identity and at least 99% identity are particularly highly preferred, with at least 99% identity being the more preferred.

Substantially as hereinbefore described the present invention further relates to polynucleotides that hybridise to the herein above-described sequences. In this regard, the present invention especially relates to polynucleotides which hybridise under stringent conditions to the herein above-described polynucleotides. As herein used, the term “stringent conditions” means hybridisation will occur only if there is at least 95% and preferably at least 97% complementary identity between the sequences.

The present invention also relates to vectors, which comprise a polynucleotide or polynucleotides of the present invention, host cells which are genetically engineered with vectors of the invention and the production of polypeptides of the invention by recombinant techniques.

The present invention, therefore, further provides a biologically functional vector system which carries a polynucleotide substantially as hereinbefore described and which is capable of introducing the polynucleotide into the genome of a host organism.

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Host cells can be genetically engineered to incorporate polynucleotides and express polypeptides of the present invention and the present invention further provides a host cell which is transformed or transfected with a polynucleotide, or one or more polynucleotides, or a vector system, each substantially as herein described. The appropriate DNA sequence
5 may be inserted into the vector by any of a variety of well-known and routine techniques.

According to a particularly preferred embodiment of the present invention, there is also provided a method of screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject (in particular a
10 human) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

- (a) providing either (i) said sample of body fluid from said subject or (ii)
15 lymphocytes isolated from said sample;
- (b) contacting said sample or isolated lymphocytes with a polypeptide according to the present invention substantially as hereinbefore described (suitably under conditions that allow interaction of a TSH receptor with
20 autoantibodies or lymphocytes produced in response to a TSH receptor) so as to permit said polypeptide to interact with autoantibodies, or lymphocytes, produced in response to a TSH receptor, and present in, or isolated from, said sample; and
- (c) monitoring the degree, or effect, of interaction of said polypeptide with
25 either said autoantibodies, or said lymphocytes, produced in response to a TSH receptor and present in, or isolated from, said sample, thereby providing an indication of the presence of said autoantibodies, or said lymphocytes, in said sample, or isolated from said sample.

30 Substantially as described above, a method according to the present invention is suitable

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for screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject. A method according to the present invention can, however, be particularly adapted for use in screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from a subject

5 substantially as hereinafter described in greater detail.

There is in particular provided by the present invention, therefore, a method of screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from a subject (in particular a human) suspected of suffering from, susceptible

10 to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

(a) providing said sample of body fluid from said subject;

15 (b) contacting said sample with a polypeptide according to the present invention substantially as hereinbefore described (suitably under conditions that allow interaction of a TSH receptor with autoantibodies produced in response to a TSH receptor) so as to permit said polypeptide to interact with autoantibodies produced in response to a TSH receptor and

20 present in said sample; and

(c) monitoring the degree of interaction of said polypeptide with said autoantibodies produced in response to a TSH receptor and present in said sample, thereby providing an indication of the presence of said

25 autoantibodies in said sample.

A method according to the present invention may typically employ a control, such as a sample of body fluid from a normal subject, in other words a subject known to be without autoimmune disease associated with an immune reaction to a TSH receptor.

30 A method of screening for autoantibodies to a TSH receptor according to the present

invention may comprise directly monitoring interaction of (i) autoantibodies to a TSH receptor present in the sample of body fluid from the subject and (ii) a polypeptide, as provided by the present invention substantially as hereinbefore described, typically by employing non-competitive sandwich type assay techniques known in the art.

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Typically, in a method according to the present invention employing non-competitive techniques, monitoring of the degree of interaction of (i) autoantibodies to a TSH receptor present in the sample and (ii) a polypeptide according to the present invention substantially as hereinbefore described, can comprise providing labelling means either to

10 a polypeptide according to the present invention substantially as hereinbefore described, or to a binding partner for autoantibodies to a TSH receptor, either of which technique would enable monitoring of the above described interaction. For example, a method according to the present invention may comprise directly or indirectly labelling a polypeptide according to the present invention substantially as hereinbefore described;

15 contacting the thus labelled polypeptide with a sample of body fluid being screened for TSH receptor autoantibodies so as to provide a mixture thereof; and adding to the mixture a binding partner for autoantibodies to a TSH receptor (such as an anti-IgG reagent) present in the sample of body fluid, so as to cause precipitation of any complexes of labelled polypeptide and TSH receptor autoantibodies present in the mixture.

20 Alternatively, it may be preferred that a method according to the present invention further comprises adding a labelled binding partner for TSH receptor autoantibodies (such as a labelled anti-IgG reagent, for example protein A or anti-human IgG, or labelled full length TSH receptor or an epitope thereof) to a mixture obtained by contacting (i) a polypeptide according to the present invention substantially as hereinbefore described

25 immobilised to a support and (ii) a sample of body fluid being screened for autoantibodies to a TSH receptor.

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It may alternatively be preferred that a method of screening for autoantibodies to a TSH receptor in the sample of body fluid according to the present invention, utilises the principles employed in known competitive assays. For example, a method according to the present invention may employ at least one competitor capable of competing with

autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described.

Typically, a competitor as employed in a competitive assay method according to the present invention may comprise one or more antibodies, which may be natural or partly or wholly synthetically produced. A competitor as employed in the present invention may alternatively comprise any other protein (for example TSH) having a binding domain or region which is capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described. Preferably, however, a competitor as employed in the present invention comprises a monoclonal, recombinant or polyclonal antibody (especially a monoclonal antibody), capable of competing with TSH receptor autoantibodies in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described.

Typically, therefore, a competitive assay method according to the present invention may further comprise providing at least one competitor, such as a monoclonal or polyclonal antibody, whereby in step (b) of a method as herein described a polypeptide according to the present invention substantially as hereinbefore described can interact with either a competitor, such as a monoclonal or polyclonal antibody, or autoantibodies to a TSH receptor present in said sample.

Typically monitoring in a competitive assay method according to the present invention comprises comparing:

- (i) interaction of a polypeptide according to the present invention substantially as hereinbefore described and one or more competitors substantially as hereinbefore described (typically a monoclonal or polyclonal antibody), in the absence of said sample of body fluid being screened (that is a suspected disease sample), optionally in the presence of a sample of body fluid from a normal subject, typically a subject known

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to be without autoimmune disease associated with an immune reaction to a TSH receptor; with

- (ii) interaction of a polypeptide according to the present invention substantially as hereinbefore described and one or more competitors substantially as hereinbefore described (typically a monoclonal or polyclonal antibody), in the presence of said sample of body fluid being screened.

Typically, the comparison involves observing a decrease in interaction of a polypeptide according to the present invention substantially as hereinbefore described and the competitor in (ii) compared to (i) so as to provide an indication of the presence of autoantibodies to a TSH receptor in said sample. Typically, the decrease in interaction can be observed by directly or indirectly labelling the competitor and monitoring any change in the interaction of the thus labelled competitor with a polypeptide according to the present invention substantially as hereinbefore described in the absence and in the presence of a sample of body fluid being screened for autoantibodies to a TSH receptor. Suitably a polypeptide according to the present invention substantially as hereinbefore described may be immobilised to facilitate the above mentioned monitoring.

Alternatively, there is also provided by the present invention a method of screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject (in particular a human) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

- (a) providing said sample of body fluid from said subject;
- (b) contacting said sample with

- (i) a full length TSH receptor (typically a recombinantly

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obtained full length TSH receptor), and

- (ii) at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described,

(suitably under conditions that allow interaction of a TSH receptor with autoantibodies to a TSH receptor), so as to permit said full length TSH receptor to interact with either autoantibodies to a TSH receptor present in said sample, or said competitor; and

- (c) monitoring the interaction of said full length TSH receptor with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

The full length TSH receptor can typically be of human, porcine, bovine, canine, feline, mouse, rat or ovine origin and more preferably a recombinantly obtained full length TSH receptor. A competitor for use in such an assay typically comprises a monoclonal or polyclonal antibody (preferably monoclonal) substantially as hereinbefore described.

Suitably a detectable label that can be employed in a method according to the present invention can be selected from the group consisting of enzymic labels, isotopic labels, chemiluminescent labels, fluorescent labels, dyes and the like

In the case where an isotopic label (such as ^{125}I , ^{14}C , ^3H or ^{35}S) is employed, monitoring may therefore comprise measuring radioactivity dependent on binding of a polypeptide according to the present invention substantially as hereinbefore described. Radioactivity is generally measured using a gamma counter, or liquid scintillation counter.

In the case of a method of screening for lymphocytes according to the present invention,

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it is generally preferred that lymphocytes are initially isolated from a sample of body fluid from a subject using techniques well known to one of ordinary skill in the art, followed by contact with a polypeptide according to the present invention so as to stimulate the proliferation of the isolated lymphocytes. Monitoring of the effect of interaction of a polypeptide according to the present invention and such proliferating lymphocytes, typically employs means known in the art for monitoring such proliferation of lymphocytes.

According to a further particularly preferred embodiment of the present invention, there is provided a kit for screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject (in particular a human) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

- (a) a polypeptide according to the present invention substantially as hereinbefore described;
- (b) means for contacting either (i) a sample of body fluid obtained from said subject, or (ii) lymphocytes isolated from a sample of body fluid obtained from said subject, with said polypeptide according to the present invention substantially as hereinbefore described (suitably under conditions that allow interaction of a TSH receptor with autoantibodies or lymphocytes produced in response to a TSH receptor) so as to permit said polypeptide to interact with autoantibodies, or lymphocytes, produced in response to a TSH receptor, and present in, or isolated from, said sample; and
- (c) means for monitoring the degree, or effect, of interaction of said polypeptide with either said autoantibodies, or said lymphocytes, produced in response to a TSH receptor and present in, or isolated from, said sample, thereby providing an indication of the presence of said autoantibodies, or lymphocytes, in said sample or isolated from said sample.

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Substantially as described above, a kit according to the present invention is suitable for screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject. A kit according to the present invention can, however, be particularly adapted for use in screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from a subject substantially as hereinafter described in greater detail.

There is in particular provided by the present invention, therefore, a kit for screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from a subject (in particular a human) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

- (a) a polypeptide according to the present invention substantially as hereinbefore described;
- (b) means for contacting a sample of body fluid obtained from said subject with said polypeptide according to the present invention substantially as hereinbefore described (suitably under conditions that allow interaction of a TSH receptor with autoantibodies produced in response to a TSH receptor) so as to permit said polypeptide to interact with autoantibodies produced in response to a TSH receptor and present in said sample; and
- (c) means for monitoring the degree of interaction of said polypeptide with said autoantibodies produced in response to a TSH receptor and present in said sample, thereby providing an indication of the presence of said autoantibodies in said sample.

A kit according to the present invention may typically further comprise control means, such as means for providing a sample of body fluid from a normal subject, in other words a subject known to be without autoimmune disease associated with an immune reaction

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to a TSH receptor.

A kit for screening for autoantibodies to a TSH receptor according to the present invention may comprise means for directly monitoring interaction of (i) autoantibodies to a TSH
5 receptor present in the sample of body fluid from the subject and (ii) a polypeptide, as provided by the present invention substantially as hereinbefore described, typically comprising non-competitive sandwich type assay means known in the art.

Typically, in a kit according to the present invention comprising non-competitive assay
10 means, means are provided for monitoring the degree of interaction of (i) autoantibodies to a TSH receptor present in the sample and (ii) a polypeptide according to the present invention substantially as hereinbefore described, and can comprise labelling means provided either to a polypeptide according to the present invention substantially as
hereinbefore described, or to a binding partner for autoantibodies to a TSH receptor, either
15 of which would enable monitoring of the above described interaction. For example, a kit according to the present invention may comprise means for directly or indirectly labelling a polypeptide according to the present invention substantially as hereinbefore described; means for contacting the thus labelled polypeptide with a sample of body fluid being
screened for a TSH receptor autoantibodies so as to provide a mixture thereof; a binding
20 partner for autoantibodies to a TSH receptor (such as an anti -IgG reagent) present in the sample of body fluid; and means for adding the binding partner to the mixture so as to cause precipitation of any complexes of labelled polypeptide and TSH receptor autoantibodies present in the mixture. Alternatively, it may be preferred that a kit according to the present invention further comprises a labelled binding partner for TSH
25 receptor autoantibodies (such as a labelled anti- IgG reagent, for example protein A or anti-human IgG, or labelled full length a TSH receptor or an epitope thereof) and means for adding the labelled binding partner to a mixture obtained by contacting (i) a polypeptide according to the present invention substantially as hereinbefore described immobilised to a support and (ii) a sample of body fluid being screened for autoantibodies
30 to a TSH receptor.

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It may alternatively be preferred that a kit for screening for autoantibodies to a TSH receptor in the sample of body fluid according to the present invention, comprises known competitive assay means. For example, a kit according to the present invention may further comprise at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described.

Typically, a competitor as employed in a competitive assay kit according to the present invention may comprise one or more antibodies, which may be natural or partly or wholly synthetically produced. A competitor as employed in the present invention may alternatively comprise any other protein having a binding domain or region which is capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described. Preferably, however, a competitor as employed in the present invention comprises a monoclonal or polyclonal antibody (especially a monoclonal antibody), capable of competing with TSH receptor autoantibodies in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described.

Typically, therefore, a competitive assay kit according to the present invention may further comprise at least one competitor, such as a monoclonal or polyclonal antibody, whereby a polypeptide according to the present invention substantially as hereinbefore described can interact with either a competitor, such as a monoclonal or polyclonal antibody, or autoantibodies to a TSH receptor present in a sample of body fluid being screened.

Typically monitoring means in a competitive assay kit according to the present invention comprise means for comparing:

- (i) interaction of a polypeptide according to the present invention substantially as hereinbefore described and one or more competitors substantially as hereinbefore described (typically a monoclonal or polyclonal antibody), in the absence of said sample of body fluid being

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screened (that is a suspected disease sample), optionally in the presence of a sample of body fluid from a normal subject, typically a subject known to be without autoimmune disease associated with an immune reaction to a TSH receptor ; with

- 5
- (ii) interaction of a polypeptide according to the present invention substantially as hereinbefore described and one or more competitors substantially as hereinbefore described (typically a monoclonal or polyclonal antibody), in the presence of said sample of body fluid being
- 10 screened.

Typically, the comparison involves observing a decrease in interaction of a polypeptide according to the present invention substantially as hereinbefore described and the competitor in (ii) compared to (i) so as to provide an indication of the presence of

15 autoantibodies to a TSH receptor in said sample. Typically, the decrease in interaction can be observed by directly or indirectly labelling the competitor and monitoring any change in the interaction of the thus labelled competitor with a polypeptide according to the present invention substantially as hereinbefore described in the absence and in the presence of a sample of body fluid being screened for autoantibodies to a TSH receptor.

20 Suitably a polypeptide according to the present invention substantially as hereinbefore described may be immobilised to facilitate the above mentioned monitoring.

Alternatively, there is also provided by the present invention a kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject (in

25 particular a human) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

- (a) a full length TSH receptor (typically a recombinantly obtained full length
- 30 TSH receptor);

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(b) at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to the present invention substantially as hereinbefore described,

5 (c) means for contacting said sample of body fluid from said subject, said full length TSH receptor and said competitor (suitably under conditions that allow interaction of a TSH receptor with autoantibodies to a TSH receptor), so as to permit said full length TSH receptor to interact with either autoantibodies to a TSH receptor present in said sample, or said
10 competitor; and

(d) means for monitoring the interaction of said full length TSH receptor with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

15

The full length TSH receptor can typically be of human, porcine, bovine, canine, feline, mouse, rat or ovine origin and more preferably a recombinantly obtained full length TSH receptor. A competitor for use in such an assay kit typically comprises a monoclonal or polyclonal antibody (preferably monoclonal) substantially as hereinbefore described.

20

Suitably a detectable label that can be employed in a kit according to the present invention can be selected from the group consisting of enzymic labels, isotopic labels, chemiluminescent labels, fluorescent labels, dyes and the like.

25

In the case where an isotopic label (such as ^{125}I , ^{14}C , ^3H or ^{35}S) is employed, monitoring means may therefore comprise means for measuring radioactivity dependent on binding of a polypeptide according to the present invention substantially as hereinbefore described. Radioactivity is generally measured using a gamma counter, or liquid scintillation counter.

30

In the case of a kit for screening for lymphocytes according to the present invention, it is generally preferred that means are provided for initially isolating lymphocytes from a

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sample of body fluid from a subject, using techniques well known to one of ordinary skill in the art, and means are also provided for contacting a polypeptide according to the present invention with such isolated lymphocytes so as to stimulate proliferation of the latter by the former. Means (again known to one of ordinary skill in the art) for
5 monitoring the effect of interaction of a polypeptide according to the present invention and such proliferating lymphocytes, are also provided in such a kit according to the present invention.

It will be appreciated from the foregoing description that the present invention provides
10 assay methods and kits for detecting autoantibodies (in particular) or lymphocytes produced in response to a TSH receptor in a sample of body fluid substantially as hereinbefore described. The detection of such autoantibodies and / or lymphocytes produced in response to a TSH receptor in the sample of body fluid (or at least the level of such autoantibodies and / or lymphocytes in the sample) is indicative of the presence
15 of autoimmune disease associated with an immune reaction to a TSH receptor in the subject from which the sample was obtained and can, therefore, enable the diagnosis of the likely onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor.

20 There is, therefore, further provided by the present invention a method of diagnosing the likely onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in a subject (in particular a human) suspected of suffering from, susceptible to, having or recovering from, autoimmune disease associated with an immune reaction to a TSH receptor, the method comprising detecting autoantibodies or lymphocytes
25 produced in response to a TSH receptor in a sample of body fluid from the subject substantially as hereinbefore described, and whereby the detected autoantibodies and / or lymphocytes can provide a diagnosis of the likely onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in the subject.

30 There is still further provided by the present invention a method of delaying or preventing the onset of autoimmune disease associated with an immune reaction to a TSH receptor

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in an animal subject (in particular a human subject) suspected of suffering from, susceptible to or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, which method comprises initially detecting autoantibodies or lymphocytes indicative of the onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in a sample of body fluid obtained from the subject substantially as hereinbefore described, thereby providing a diagnosis of the likely onset of autoimmune disease associated with an immune reaction to a TSH receptor in the subject, and thereafter therapeutically treating the subject so as to delay the onset and / or prevent autoimmune disease associated with an immune reaction to a TSH receptor.

A polypeptide according to the present invention substantially as hereinbefore described is particularly suitable for use in the therapeutic treatment of autoimmune disease associated with an immune reaction to a TSH receptor. For example, tolerance can be achieved by administering a polypeptide according to the present invention substantially as hereinbefore described to a subject (in particular a human subject) suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor.

There is, therefore, further provided by the present invention a pharmaceutical composition comprising a polypeptide according to the present invention substantially as hereinbefore described, together with a pharmaceutically acceptable carrier, diluent or excipient therefor, wherein the polypeptide can interact with autoantibodies and / or lymphocytes produced in response to a TSH receptor.

The present invention further provides a polypeptide according to the present invention substantially as hereinbefore described for use in the manufacture of a medicament for the treatment of Graves' disease.

Compositions or medicaments according to the present invention should contain a therapeutic or prophylactic amount of at least one polypeptide according to the present invention in a pharmaceutically-acceptable carrier. The pharmaceutical carrier can be any

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compatible, non-toxic substance suitable for delivery of the polypeptides to the patient. Sterile water, alcohol, fats, waxes, and inert solids may be used as the carrier. Pharmaceutically-acceptable adjuvants, buffering agents, dispersing agents and the like, may also be incorporated into the pharmaceutical compositions. Such compositions can
5 contain a single polypeptide or may contain two or more polypeptides according to the present invention.

It may be desirable to couple a polypeptide according to the present invention to immunoglobulins, e.g. IgG, or to lymphoid cells from the patient being treated in order
10 to promote tolerance. Such an approach is described in Bradley-Mullen, *Activation of Distinct Subsets of T Suppressor Cells with Type III Pneumococcal Polysaccharide Coupled to Syngeneic Spleen Cells*, in: IMMUNOLOGICAL TOLERANCE TO SELF AND NON-SELF, Buttisto et al., eds., Annals N.Y. Acad. Sci. Vol. 392, pp 156-166, 1982. Alternatively, the polypeptides may be modified to maintain or enhance binding
15 to the MHC while reducing or eliminating binding to the associated T-cell receptor. In this way, the modified polypeptides may compete with natural a TSH receptor to inhibit helper T-cell activation and thus inhibit the immune response. In all cases, care should be taken that administration of the pharmaceutical compositions of the present invention ameliorate but do not potentiate the autoimmune response.

20 Pharmaceutical compositions according to the present invention are useful for parenteral administration. Preferably, the compositions will be administered parenterally, i.e. subcutaneously, intramuscularly, or intravenously. Thus, the invention provides compositions for parenteral administration to a patient, where the compositions comprise
25 a solution or dispersion of the polypeptides in an acceptable carrier, as described above. The concentration of the polypeptides in the pharmaceutical composition can vary widely, i.e. from less than about 0.1% by weight, usually being at least about 1% by weight to as much as 20% by weight or more. Typical pharmaceutical compositions for intramuscular injection would be made up to contain, for example, 1 ml of sterile buffered water and 1
30 to 100 µg of a purified polypeptide of the present invention. A typical composition for intravenous infusion could be made up to contain 100 to 500 ml of sterile Ringer's

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solution and 100 to 500 mg of a purified polypeptide of the present invention. Actual methods for preparing parenterally administrable compositions are well known in the art and described in more detail in various sources, including, for example, *Remington's Pharmaceutical Science*, 15th Edition, Mack Publishing Company, Easton, Pa. (1980).

5

In addition to using a polypeptide according to the present invention directly in pharmaceutical compositions, it is also possible to use a polypeptide according to the present invention to enhance tolerance to a TSH receptor in a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, employing the following principles. More particularly, peripheral blood lymphocytes can be collected from the subject in a conventional manner and stimulated by exposure to a polypeptide according to the present invention, as defined above. Usually, other mitogens and growth enhancers will be present, e.g., phytohemagglutinin, interleukin 2, and the like. Proliferating T-helper cells may be isolated and cloned, also under the stimulation of a polypeptide according to the present invention. Clones which continue to proliferate may then be used to prepare therapeutic compositions for the subject. The cloned T-cells may be attenuated, e.g. by exposure to radiation, and administered to the subject in order to induce tolerance. Alternatively, the T-cell receptor or portions thereof may be isolated by conventional protein purification methods from the cloned T-cells and administered to the individual. Such immunotherapy methods are described generally in Sinha et al. (1990) *Science* 248:1380-1388.

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In some cases, after a T-helper cell has been cloned as described above, it may be possible to develop therapeutic peptides from the T-cell receptor, where the peptides would be beneficial for treating a patient population suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor. In such cases, the T-cell receptor gene may be isolated and cloned by conventional techniques and peptides based on the receptor produced by recombinant techniques as described above. The recombinantly-produced peptides may then be incorporated in pharmaceutical compositions as described above.

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There is also provided by the present invention a method of cloning lymphocytes produced in response to a TSH receptor, which method comprises:

providing a source of lymphocytes;

5

contacting the lymphocytes with a polypeptide according to the present invention substantially as hereinbefore described, so as to effect proliferation of said lymphocytes; and

10

isolating and cloning the proliferating lymphocytes.

The present invention also provides the use of cloned lymphocytes prepared as above, in the therapeutic treatment of autoimmune disease associated with an immune reaction to a TSH receptor. There is provided, therefore, a pharmaceutical composition comprising

15 cloned lymphocytes prepared as above, together with a pharmaceutically acceptable carrier, diluent or excipient therefor and the use of such cloned lymphocytes in the manufacture of a medicament for the treatment of autoimmune disease associated with an immune reaction to a TSH receptor, in particular Graves' disease.

20

There is also provided by the present invention one or more therapeutic agents identified as providing a therapeutic effect by interaction with amino acids comprising part or all of the primary conformation of amino acids of one or more epitopes of a TSH receptor substantially as hereinbefore described, and the present invention further provides one or more therapeutic agents for use in therapeutically interacting with amino acids comprising

25 part or all of the primary conformation of amino acids of one or more epitopes of a TSH receptor substantially as hereinbefore described and as such for use in the therapeutic treatment of an autoimmune disease associated with an immune reaction to a TSH receptor.

30

There is, therefore, still further provided by the present invention a method of treating autoimmune disease associated with an immune reaction to a TSH receptor in a subject,

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which method comprises initially detecting autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from the subject substantially as hereinbefore described, thereby providing a diagnosis of autoimmune disease in the subject, and administering to the subject a therapeutically effective amount of at least one therapeutic agent effective in the treatment of such autoimmune disease, such as a polypeptide according to the present invention substantially as hereinbefore described.

The present invention also provides a method of treating autoimmune disease associated with an immune reaction to a TSH receptor in a subject (in particular a human subject), which method comprises administering to the subject a therapeutically effective amount of a therapeutic agent identified as providing a therapeutic effect by interaction with amino acids comprising part or all of the primary conformation of amino acids of one or more epitopes of a TSH receptor substantially as hereinbefore described

The amount of therapeutic agent administered will depend on the specific autoimmune disease state being treated, possibly the age of the patient and will ultimately be at the discretion of an attendant physician.

There is still further provided by the present invention, in combination, a kit substantially as hereinbefore described, together with a therapeutically effective amount of at least one therapeutic agent effective in the treatment of autoimmune disease associated with an immune reaction to a TSH receptor substantially as hereinbefore described.

Substantially as hereinbefore described, the sample of body fluid being screened by the present invention will typically comprise blood samples or other fluid blood fractions, such as in particular serum samples or plasma samples, but the sample may in principle be another biological fluid, such as saliva or urine or solubilised tissue extracts, or may be obtained by needle biopsy.

There is still further provided by the present invention a binding partner for a TSH

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receptor, such as an antibody to a TSH receptor, or a fragment of an antibody to a TSH receptor, which binding partner can interact with one or more epitopes to a TSH receptor substantially as hereinbefore described, in particular amino acid numbers 277 to 296 of a TSH receptor. Suitably, antibodies provided by the present invention can be
5 monoclonal (preferred), recombinant or polyclonal. Typically an antibody, such as a monoclonal antibody, as provided by the present invention is in substantially purified form.

More specifically, a monoclonal antibody as provided by the present invention can
10 comprise any of monoclonal antibodies 3C7, 2B4, 8E2, 18C5, 4D7, 16E5, 17D2, 3B3 and 14D3 or active fragments thereof, as described in the Examples and further illustrated by the accompanying Figures. Antibodies such as 2B4, 8E2, 18C5, 4D7, 16E5, 17D2, 3B3 and 14D3, or active fragments thereof, as described in the Examples preferably have a high affinity for a TSH receptor, such as at least about 10^8molar^{-1} . There is, therefore,
15 further provided by the present invention a monoclonal antibody having an affinity of at least about 10^8molar^{-1} for one or more epitopes of a TSH receptor and which epitope is provided by any one of the following amino acid sequences of a TSH receptor:

amino acids 22 to 91 of a TSH receptor; or

20 amino acids 246 to 260 of a TSH receptor;

or more particularly, consists essentially of any one of the following amino acid sequences of a TSH receptor:

25 amino acids 36 to 42 of a TSH receptor; or

amino acids 247 to 260 of a TSH receptor.

There is also provided by the present invention a monoclonal antibody having an affinity of at least about 10^8molar^{-1} for one or more epitopes of a TSH receptor and which epitope
30 is provided by any one of the following amino acid sequences of a TSH receptor:

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amino acids 32 to 41 of a TSH receptor; or
amino acids 277 to 296 of a TSH receptor.

According to a particularly preferred embodiment of the present invention there is
5 provided a binding partner for a TSH receptor, which binding partner is capable of binding
to a TSH receptor so as to stimulate the TSH receptor, which binding partner does not
comprise TSH or naturally produced autoantibodies to the TSH receptor.

Preferably the binding partner comprises an antibody, in particular a monoclonal or
10 recombinant (preferably monoclonal) antibody, capable of binding to a TSH receptor so
as to stimulate the TSH receptor. Examples of monoclonal antibodies disclosed herein
which stimulate a TSH receptor in this way include 4D7, 16E5, 17D2 and 14D3.

In a preferred case the present invention provides a binding partner for a TSH receptor,
15 which binding partner is capable of binding to the TSH receptor so as to stimulate the
TSH receptor and which comprises:

an antibody V_H domain selected from the group consisting of:

20 V_H domains as shown in any one of Figures 10, 14, 18, 22, 42, 46 or 50, a V_H
domain comprising one or more V_H CDRs with an amino acid sequence
corresponding to a V_H CDR as shown in Figure 10, a V_H domain comprising one
or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as
shown in Figure 14, a V_H domain comprising one or more V_H CDRs with an
25 amino acid sequence corresponding to a V_H CDR as shown in Figure 18, a V_H
domain comprising one or more V_H CDRs with an amino acid sequence
corresponding to a V_H CDR as shown in Figure 22, a V_H domain comprising one
or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as
shown in Figure 42, a V_H domain comprising one or more V_H CDRs with an
30 amino acid sequence corresponding to a V_H CDR as shown in Figure 46, and a V_H
domain comprising one or more V_H CDRs with an amino acid sequence

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corresponding to a V_H CDR as shown in Figure 50; and / or

an antibody V_L domain selected from the group consisting of:

5 V_L domains as shown in any one of Figures 12, 16, 20, 24, 44, 48 or 52, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 12, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 16, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 20, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 24, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 44, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 48, and a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 52.

It may be preferred according to the present invention that a binding partner substantially as hereinbefore described comprises an antibody V_H domain substantially as hereinbefore described paired with an antibody V_L domain substantially as hereinbefore described to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor, although as discussed further an antibody V_H domain, or an antibody V_L domain, may be independently used to bind a TSH receptor. It will be appreciated, therefore, that a binding partner substantially as hereinbefore described can comprise an antibody V_H domain substantially as hereinbefore described in the absence of an antibody V_L domain. It will also be appreciated, therefore, that a binding partner substantially as hereinbefore described can comprise an antibody V_L domain substantially as hereinbefore described in the absence of an antibody V_H domain. Alternatively, a binding partner substantially as hereinbefore described can comprise an antibody V_H domain paired with an antibody V_L domain substantially as hereinbefore described to provide an antibody binding site

comprising both V_H and V_L domains for a TSH receptor.

Preferred embodiments according to the present invention can thus include a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 10 paired with an antibody V_L domain as shown in Figure 12 to provide an antibody binding site, comprising both these V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 14 paired with an antibody V_L domain as shown in Figure 16 to provide an antibody binding site, comprising both these V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 18 paired with an antibody V_L domain as shown in Figure 20 to provide an antibody binding site comprising both these V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 22 paired with an antibody V_L domain as shown in Figure 24 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 42 paired with an antibody V_L domain as shown in Figure 44 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 46 paired with an antibody V_L domain as shown in Figure 48 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or a binding partner substantially as hereinbefore described comprising an antibody V_H domain as shown in Figure 50 paired with an antibody V_L domain as shown in Figure 52 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor.

It is further envisaged according to the present invention that V_H domains substantially as hereinbefore described may be paired with V_L domains other than those specifically described herein. It is also further envisaged according to the present invention that V_L domains substantially as hereinbefore described may be paired with V_H domains other than those specifically described herein.

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According to an alternative embodiment of the present invention there is provided a binding partner substantially as hereinbefore described for a TSH receptor, which binding partner is capable of binding to the TSH receptor so as to stimulate the TSH receptor and which can comprise:

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an antibody V_H domain comprising:

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a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 10, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 14, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 18, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 22, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 42, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 46, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 50; and / or

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an antibody V_L domain comprising:

25

a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 12, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 16, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 20, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 24, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 44, or a V_L domain comprising one or more V_L CDRs with an

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amino acid sequence corresponding to a V_L CDR as shown in Figure 48, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 52.

- 5 One or more CDRs as referred to above may be taken from the hereinbefore described V_H and V_L domains and incorporated into a suitable framework. For example, the amino acid sequence of one or more CDRs substantially as hereinbefore described may be incorporated into framework regions of antibodies differing from those specifically disclosed herein, such antibodies thereby incorporating the one or more CDRs and being
- 10 capable of binding to the TSH receptor, preferably to stimulate the TSH receptor substantially as hereinbefore described. Alternatively, a binding partner according to the present invention may comprise a polypeptide capable of binding to the TSH receptor so as to stimulate the TSH receptor substantially as hereinbefore described and comprising the primary structural conformation of amino acids as represented by one or more CDRs
- 15 as specifically described herein, optionally together with further amino acids, which further amino acids may enhance the binding affinity of one or more CDRs as described herein for a TSH receptor or may have substantially no role in affecting the binding properties of the polypeptide for a TSH receptor.
- 20 Preferably a binding partner according to the present invention includes an antibody. The term "antibody" as used herein describes an immunoglobulin whether natural or partly or wholly synthetically produced. The term also covers any polypeptide having a binding domain which is, or is substantially homologous to, an antibody binding domain. Examples of antibodies are the immunoglobulin isotypes and their isotypic subclasses and
- 25 fragments which comprise an antigen binding domain such as Fab, scFv or the like.

In particular, fragments of antibodies specifically as herein described form an important aspect of the present invention. In this way, where a binding partner according to the present invention comprises an antibody substantially as hereinbefore described, the

30 antibody may comprise any of the following fragments: (i) the Fab fragment consisting of V_L , V_H , C_L and C_H1 domains; (ii) the Fd fragment consisting of the V_H and C_H1

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domains; (iii) the Fv fragment consisting of the V_L and V_H domains; (iv) the dAb fragment which consists of a V_H domain; (v) isolated CDR regions; (vi) F(ab')₂ fragments, a bivalent fragment comprising two linked Fab fragments; and (vii) single chain Fv molecules (scFv), wherein a V_H domain and a V_L domain are linked by a peptide linker which allows the two domains to associate to form an antigen binding site.

Alternatively, in the case where a binding partner according to the present invention comprises an antibody, the antibody may comprise a whole antibody, whereby the antibody includes variable and constant regions, which variable and constant regions can be further illustrated for the antibodies provided by the present invention by reference to any of Figures 9 to 24, or 41 to 52.

The present invention, also encompasses variants, analogs and derivatives of the specific binding partners, antibodies, V_H domains, V_L domains, CDRs and polypeptides disclosed herein, which variants, analogs and derivatives retain the ability to bind to the TSH receptor so as to stimulate the TSH receptor substantially as hereinbefore described. The terms variants, analogs and derivatives are substantially herein before further described in greater detail with respect to polypeptides according to the present invention and what is meant by these terms as hereinbefore described applies also to variants, analogs and derivatives of the specific binding partners according to the present invention.

The present invention also provides a further binding partner capable of binding to the TSH receptor so as to stimulate the TSH receptor substantially as hereinbefore described, and which further binding partner can compete for binding to the TSH receptor with any specific binding partner disclosed herein, which further binding partner does not comprise TSH or autoantibodies to a TSH receptor. In particular this further binding partner may comprise a further antibody having a binding site for an epitope region of a TSH receptor suitably as hereinbefore described, which further antibody is capable of binding to the TSH receptor so as to stimulate the TSH receptor substantially as hereinbefore described and can compete for binding to the TSH receptor with any specific binding partner disclosed herein.

There is also provided by the present invention a polynucleotide comprising:

- 5 (i) a nucleotide sequence as shown in any of Figures 25 to 40, or 53 to 64; or parts of such sequences as shown in Figures 26, 28, 30, 32, 34, 36, 38, 40, 54, 56, 58, 60, 62, or 64, encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR as shown in any of Figures 10, 12, 14, 16, 18, 20, 22, 24, 42, 44, 46, 48, 50 or 52;
- 10 (ii) a nucleotide sequence encoding a binding partner substantially as hereinbefore described, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR of a binding partner substantially as hereinbefore described;
- 15 (iii) a nucleotide sequence encoding a binding partner having a primary structural conformation of amino acids as shown in any of Figures 9 to 24 or 41 to 52, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR as shown in any of Figures 10, 12, 14, 16, 18, 20, 22, 24, 42, 44, 46, 48, 50 or 52;
- 20 (iv) a nucleotide sequence differing from any sequence of (i) in codon sequence due to the degeneracy of the genetic code.
- (v) a nucleotide sequence comprising an allelic variation of any sequence of (i);
- 25 (vi) a nucleotide sequence comprising a fragment of any of the sequences of (i), (ii), (iii), (iv) or (v), and in particular a nucleotide sequence comprising a fragment of any of the sequences of (i), (ii), (iii), (iv) or (v) and encoding a Fab fragment, a Fd fragment, a Fv fragment, a dAb fragment, an isolated CDR region, F(ab')₂ fragments or a scFv fragment, of a binding partner
- 30 substantially as hereinbefore described;

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- (vii) a nucleotide sequence differing from the any sequence of (i) due to mutation, deletion or substitution of a nucleotide base and encoding a binding partner substantially as hereinbefore described, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR of a binding partner substantially as hereinbefore described.

Variant polynucleotides according to the present invention are suitably at least 70% identical over their entire length to any polynucleotide sequence of (i), most highly preferred are polynucleotides that comprise a region that is at least 80% identical over its entire length to any polynucleotide sequence of (i), polynucleotides at least 90% identical over their entire length to any polynucleotide sequence of (i) are particularly preferred, and among these particularly preferred polynucleotides, those with at least 95% identity are especially preferred. What is meant by variants of specific polynucleotide sequences described herein is hereinbefore described in greater detail.

The present invention further provides a biologically functional vector system which carries a polynucleotide substantially as hereinbefore described and which is capable of introducing the polynucleotide into the genome of a host organism.

The present invention also relates to host cells which are transformed with polynucleotides of the invention and the production of binding partners of the invention by recombinant techniques. Host cells can be genetically engineered to incorporate polynucleotides and express binding partners of the present invention.

A binding partner substantially as hereinbefore described may have diagnostic and therapeutic applications, and may advantageously interact or bind with one or more epitope regions of a TSH receptor substantially as hereinbefore described.

Accordingly, a binding partner substantially as hereinbefore described can be employed in screening methods for detecting autoantibodies substantially as hereinbefore described and also in diagnostic methods substantially as hereinbefore described. In this way,

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binding partners according to the present invention can be employed in place of competitors hitherto described for use in screening methods for detecting autoantibodies substantially as hereinbefore described and also in diagnostic methods substantially as hereinbefore described. Similarly, binding partners according to the present invention can be employed in place of competitors hitherto described for use in kits for use in detecting autoantibodies substantially as hereinbefore described.

The present invention also provides a method of screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

(a) providing said sample of body fluid from said subject;

(b) contacting said sample with

(i) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor, and

(ii) one or more binding partners substantially as hereinbefore described;

(suitably under conditions that allow interaction of a TSH receptor with autoantibodies produced in response to a TSH receptor) so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding partners; and

(c) monitoring the interaction of said TSH receptor, said one or more epitopes thereof or said polypeptide, with said autoantibodies present in said

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sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

Preferably, a method according to the present invention as referred to above, further
5 comprises providing labelling means for the one or more binding partners, suitable labelling means being substantially as hereinbefore described.

The present invention also provides a method of screening for autoantibodies produced
in response to a TSH receptor in a sample of body fluid obtained from a subject suspected
10 of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

(a) providing said sample of body fluid from said subject;

15 (b) contacting said sample with

(i) a full length TSH receptor, one or more epitopes thereof or
a polypeptide comprising one or more epitopes of a TSH
receptor, and

20 (ii) one or more binding members for a TSH receptor;

(suitably under conditions that allow interaction of a TSH receptor
with autoantibodies produced in response to a TSH receptor) so as
25 to permit said TSH receptor, said one or more epitopes thereof or
said polypeptide, to interact with either autoantibodies to a TSH
receptor present in said sample, or said one or more binding
members; and

30 (c) monitoring the interaction of said TSH receptor, said one or more epitopes
thereof or said polypeptide, with said autoantibodies present in said

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sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample;

wherein said one or more binding members are directly or indirectly immobilised to a surface either prior to, or after step (b).

Typically the one or more binding members comprise one or more binding partners according to the present invention substantially as hereinbefore described. Suitably, labelling means are provided for the TSH receptor, the one or more epitopes thereof or the polypeptide.

The present invention also provides a kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

- (a) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor;
- (b) one or more binding partners substantially as hereinbefore described;
- (c) means for contacting said sample of body fluid from said subject, said TSH receptor, said one or more epitopes thereof or said polypeptide, and said one or more binding partners, (suitably under conditions that allow interaction of a TSH receptor with autoantibodies produced in response to a TSH receptor) so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding partners; and
- (d) means for monitoring the interaction of said TSH receptor, said one or

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more epitopes thereof or said polypeptide, with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

- 5 Suitably, a kit as referred to above further comprises labelling means for the one or more binding partners, suitable labelling means being substantially as hereinbefore described.

The present invention also provides a kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune
10 reaction to a TSH receptor, said kit comprising:

- (a) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor;
- 15 (b) one or more binding members for a TSH receptor;
- (c) means for contacting said sample of body fluid from said subject, said TSH receptor, said one or more epitopes thereof or said polypeptide, and said one or more binding members, (suitably under conditions that allow
20 interaction of a TSH receptor with autoantibodies produced in response to a TSH receptor) so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding
25 members;
- (d) means for directly or indirectly immobilising said one or more binding members to a surface, either before or after contacting said one or more binding members with said sample of body fluid from said subject and said TSH receptor, said one or more epitopes thereof or said polypeptide;
30 and

- (e) means for monitoring the interaction of said TSH receptor, said one or more epitopes thereof or said polypeptide, with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

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Typically the one or more binding members comprise one or more binding partners according to the present invention substantially as hereinbefore described. Suitably, labelling means are provided for the TSH receptor, the one or more epitopes thereof or the polypeptide.

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Suitably a method or kit as referred to above can employ a polypeptide or epitope according to the present invention substantially as hereinbefore described.

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Substantially as hereinbefore described, in the presence of autoantibodies to the TSH receptor, binding of the TSH receptor to the immobilised binding member or binding partner will be decreased. Such a method and kit for screening for autoantibodies to a TSH receptor can be advantageous in alleviating problems that can be associated with TSH receptor when immobilised to a surface.

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A binding partner substantially as hereinbefore described can also be usefully employed in therapy. There is, therefore, further provided by the present invention methods of treatment comprising administration of a specific binding partner substantially as hereinbefore described, pharmaceutical compositions comprising a specific binding partner substantially as hereinbefore described (together with one or more pharmaceutically acceptable carriers, diluents or excipients therefor), and use of a specific binding partner substantially as hereinbefore described in the manufacture of a medicament or composition, in particular a medicament or composition for use in stimulating thyroid tissue, and / or tissue containing a TSH receptor. In particular, a specific binding partner according to the present invention can be employed in oncology, and in particular for use

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in the diagnosis, management and treatment of thyroid cancer.

Pharmaceutical compositions according to the present invention include those suitable for oral, parenteral and topical administration, although the most suitable route will generally depend upon the condition of a patient and the specific disease being treated. The precise amount of a binding partner substantially as hereinbefore described to be administered to a patient will be the responsibility of an attendant physician, although the dose employed will depend upon a number of factors, including the age and sex of the patient, the specific disease being treated and the route of administration substantially as described above.

There is further provided by the present invention a method of stimulating thyroid tissue, and / or tissue containing a TSH receptor, which method comprises administering to a patient in need of such stimulation a diagnostically or therapeutically effective amount of a binding partner substantially as hereinbefore described.

The present invention also provides in combination, a binding partner substantially as hereinbefore described, together with one or more further agents capable of stimulating thyroid tissue, and / or tissue containing a TSH receptor, for simultaneous, separate or sequential use in stimulating thyroid tissue, and / or tissue containing a TSH receptor. Preferably the one or more further agents comprise recombinant human TSH and / or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments. Alternatively, the one or more further agents can act independently of binding to the TSH receptor.

The following illustrative explanations are provided to facilitate understanding of certain terms used herein. The explanations are provided as a convenience and are not limitative of the invention

BINDING PARTNER, or BINDING MEMBER, FOR A TSH RECEPTOR, describes a molecule having a binding specificity for a TSH receptor. A binding partner or binding member as described herein may be naturally derived or wholly or partially synthetically produced. Such a binding partner or binding member has a domain or region which specifically binds to and is therefore complementary to one or more epitope regions of a

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TSH receptor.

C DOMAIN denotes a region of relatively constant amino acid sequence in antibody molecules.

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CDR denotes complementarity determining regions which are present on both heavy and light chains of antibody molecules and represent regions of most sequence variability. CDRs represent approximately 15 to 20% of variable domains and represent antigen binding sites of an antibody.

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FR denotes framework regions and represent the remainder of the variable light domains and variable heavy domains not present in CDRs.

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HC denotes part of a heavy chain of an antibody molecule comprising the heavy chain variable domain and the first domain of an IgG constant region.

HOST CELL is a cell which has been transformed or transfected, or is capable of transformation or transfection by an exogenous polynucleotide sequence.

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IDENTITY, as known in the art, is the relationship between two or more polypeptide sequences, or two or more polynucleotide sequences, as determined by comparing the sequences.

LC denotes a light chain of an antibody molecule.

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STIMULATION OF A TSH RECEPTOR by a binding partner or binding member as described herein denotes the ability of the binding partner or binding member to bind to a TSH receptor and to thereby effect, for example, production of cyclic AMP as a result of such binding to the TSH receptor. Such stimulation is analogous to the responses seen on binding of TSH, or TSH receptor autoantibodies, to a TSH receptor and in this way a binding partner or binding member as described herein mimics the effect of TSH, or TSH

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receptor autoantibody, binding to a TSH receptor.

V DOMAIN denotes a region of highly variable amino acid sequence in antibody molecules.

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V_HDOMAIN denotes variable regions or domains in heavy chains of antibody molecules.

V_LDOMAIN denotes variable regions or domains in light chains of antibody molecules.

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The present invention will now be illustrated by the following Figures and Examples, which do not limit the scope of the invention in any way.

Figure 1 lists amino acids 1 to 200 of (in the following order) human, porcine, bovine, feline, canine, mouse, rat and ovine TSH receptors.

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Figure 2 lists nucleotide bases 1 to 300 coding for regions of (in the following order) feline, bovine, canine, mouse, porcine, rat, ovine and human TSH receptors.

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Figure 3 lists amino acids 200 to 300 of (in the following order) human, porcine, bovine, feline, canine, mouse, rat and ovine TSH receptors.

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Figure 4 lists nucleotide bases 700 to 899 coding for regions of (in the following order) feline, bovine, canine, mouse, porcine, rat, ovine and human TSH receptors.

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Figure 5 lists amino acids 250 to 449 of (in the following order) human, porcine, bovine, feline, canine, mouse, rat and ovine TSH receptors.

Figure 6 lists nucleotide bases 750 to 1100 coding for regions of (in the following order) feline, bovine, canine, mouse, porcine, rat, ovine and human TSH receptors.

Figure 7 lists amino acids 350 to 500 of (in the following order) human, porcine, bovine,

feline, canine, mouse, rat and ovine TSH receptors.

Figure 8 lists nucleotide bases 1100 to 1299 coding for regions of (in the following order) feline, bovine, canine, mouse, porcine, rat, ovine and human TSH receptors.

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Figure 9 lists amino acids of the heavy chain (HC) of 4D7.

Figure 10 lists amino acids of the heavy chain (HC) of 4D7, showing the variable region or domain (namely amino acid numbers 10 to 115), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 104) and the constant region or domain (namely amino acid numbers 116 to 200).

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Figure 11 lists amino acids of the light chain (LC) of 4D7.

Figure 12 lists amino acids of the light chain (LC) of 4D7, showing the variable region or domain (namely amino acid numbers 9 to 111), the CDRs (namely CDR1 amino acid numbers 24 to 38, CDRII amino acid numbers 54 to 60 and CDRIII amino acid numbers 93 to 101) and the constant region or domain (namely amino acids numbers 112 to 211).

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Figure 13 lists amino acids of the heavy chain (HC) of 16E5.

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Figure 14 lists amino acids of the heavy chain (HC) of 16E5, showing the variable region or domain (namely amino acid numbers 9 to 120), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 109) and the constant region or domain (namely amino acid numbers 121 to 205).

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Figure 15 lists amino acids of the light chain (LC) of 16E5.

Figure 16 lists amino acids of the light chain (LC) of 16E5, showing the variable region or domain (namely amino acid numbers 9 to 107), the CDRs (namely CDR1 amino acid numbers 24 to 34, CDRII amino acid numbers 50 to 56 and CDRIII amino acid numbers

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89 to 97) and the constant region or domain (namely amino acids numbers 108 to 207).

Figure 17 lists amino acids of the heavy chain (HC) of 17D2.

5 Figure 18 lists amino acids of the heavy chain (HC) of 17D2, showing the variable region or domain (namely amino acid numbers 9 to 120), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 109) and the constant region or domain (namely amino acid numbers 121 to 205).

10 Figure 19 lists amino acids of the light chain (LC) of 17D2.

Figure 20 lists amino acids of the light chain (LC) of 17D2, showing the variable region or domain (namely amino acid numbers 9 to 107), the CDRs (namely CDR1 amino acid numbers 24 to 34, CDRII amino acid numbers 50 to 56 and CDRIII amino acid numbers 89 to 97) and the constant region or domain (namely amino acids numbers 108 to 207).

Figure 21 lists amino acids of the heavy chain (HC) of 14D3.

20 Figure 22 lists amino acids of the heavy chain (HC) of 14D3, showing the variable region or domain (namely amino acid numbers 9 to 120), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 109) and the constant region or domain (namely amino acid numbers 121 to 205).

Figure 23 lists amino acids of the light chain (LC) of 14D3.

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Figure 24 lists amino acids of the light chain (LC) of 14D3, showing the variable region or domain (namely amino acid numbers 9 to 107), the CDRs (namely CDR1 amino acid numbers 24 to 34, CDRII amino acid numbers 50 to 56 and CDRIII amino acid numbers 89 to 97) and the constant region or domain (namely amino acids numbers 108 to 207).

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Figure 25 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 4D7 as

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shown in Figure 9.

Figure 26 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 4D7 as shown in Figure 9, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 10.

Figure 27 lists nucleotide bases encoding amino acids of the light chain (LC) of 4D7 as shown in Figure 11.

Figure 28 lists nucleotide bases encoding amino acids of the light chain (LC) of 4D7 as shown in Figure 11, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 12.

Figure 29 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 16E5 as shown in Figure 13.

Figure 30 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 16E5 as shown in Figure 13, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 14.

Figure 31 lists nucleotide bases encoding amino acids of the light chain (LC) of 16E5 as shown in Figure 15.

Figure 32 lists nucleotide bases encoding amino acids of the light chain (LC) of 16E5 as shown in Figure 15, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 16.

Figure 33 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 17D2 as shown in Figure 17.

Figure 34 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 17D2

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as shown in Figure 17, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 18.

Figure 35 lists nucleotide bases encoding amino acids of the light chain (LC) of 17D2 as shown in Figure 19.

Figure 36 lists nucleotide bases encoding amino acids of the light chain (LC) of 17D2 as shown in Figure 19, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 20.

Figure 37 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 14D3 as shown in Figure 21.

Figure 38 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 14D3 as shown in Figure 21, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 22.

Figure 39 lists nucleotide bases encoding amino acids of the light chain (LC) of 14D3 as shown in Figure 23.

Figure 40 lists nucleotide bases encoding amino acids of the light chain (LC) of 14D3 as shown in Figure 23, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 24.

Figure 41 lists amino acids of the heavy chain (HC) of 3B3.

Figure 42 lists amino acids of the heavy chain (HC) of 3B3, showing the variable region or domain (namely amino acid numbers 8 to 112), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 101) and the constant region or domain (namely amino acid numbers 113 to 196).

Figure 43 lists amino acids of the light chain (LC) of 3B3.

Figure 44 lists amino acids of the light chain (LC) of 3B3, showing the variable region or domain (namely amino acid numbers 9 to 111), the CDRs (namely CDR1 amino acid numbers 24 to 38, CDRII amino acid numbers 54 to 60 and CDRIII amino acid numbers 93 to 101) and the constant region or domain (namely amino acids numbers 112 to 211).

Figure 45 lists amino acids of the heavy chain (HC) of 3C7.

Figure 46 lists amino acids of the heavy chain (HC) of 3C7, showing the variable region or domain (namely amino acid numbers 10 to 115), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 104) and the constant region or domain (namely amino acid numbers 116 to 200).

Figure 47 lists amino acids of the light chain (LC) of 3C7.

Figure 48 lists amino acids of the light chain (LC) of 3C7, showing the variable region or domain (namely amino acid numbers 9 to 111), the CDRs (namely CDR1 amino acid numbers 24 to 38, CDRII amino acid numbers 54 to 60 and CDRIII amino acid numbers 93 to 101) and the constant region or domain (namely amino acids numbers 112 to 211).

Figure 49 lists amino acids of the heavy chain (HC) of 2B4.

Figure 50 lists amino acids of the heavy chain (HC) of 2B4, showing the variable region or domain (namely amino acid numbers 9 to 122), the CDRs (namely CDR1 amino acid numbers 31 to 35, CDRII amino acid numbers 50 to 66 and CDRIII amino acid numbers 99 to 111) and the constant region or domain (namely amino acid numbers 123 to 207).

Figure 51 lists amino acids of the light chain (LC) of 2B4.

Figure 52 lists amino acids of the light chain (LC) of 2B4, showing the variable region or

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domain (namely amino acid numbers 9 to 112), the CDRs (namely CDR1 amino acid numbers 24 to 39, CDRII amino acid numbers 78 to 82 and CDRIII amino acid numbers 94 to 102) and the constant region or domain (namely amino acids numbers 113 to 212).

5 Figure 53 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 3B3 as shown in Figure 41.

Figure 54 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 3B3 as shown in Figure 41, and shows the nucleotide bases encoding the variable region or
10 domain, the CDRs and the constant region or domain as shown in Figure 42.

Figure 55 lists nucleotide bases encoding amino acids of the light chain (LC) of 3B3 as shown in Figure 43.

15 Figure 56 lists nucleotide bases encoding amino acids of the light chain (LC) of 3B3 as shown in Figure 43, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 44.

Figure 57 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 3C7 as
20 shown in Figure 45.

Figure 58 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 3C7 as shown in Figure 45, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 46.

25 Figure 59 lists nucleotide bases encoding amino acids of the light chain (LC) of 3C7 as shown in Figure 47.

Figure 60 lists nucleotide bases encoding amino acids of the light chain (LC) of 3C7 as
30 shown in Figure 47, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 48.

Figure 61 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 2B4 as shown in Figure 49.

Figure 62 lists nucleotide bases encoding amino acids of the heavy chain (HC) of 2B4 as shown in Figure 49, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 50.

Figure 63 lists nucleotide bases encoding amino acids of the light chain (LC) of 2B4 as shown in Figure 51.

Figure 64 lists nucleotide bases encoding amino acids of the light chain (LC) of 2B4 as shown in Figure 51, and shows the nucleotide bases encoding the variable region or domain, the CDRs and the constant region or domain as shown in Figure 52.

More specifically, the Figures 1 to 8 illustrate the following:

Figure 1 lists amino acids 1 to 200 of TSH receptors in the above mentioned species, which include the following amino acid sequences employed in the present invention:

amino acids 22 to 91 of a TSH receptor;
amino acids 32 to 41 of a TSH receptor; and
amino acids 36 to 42 of a TSH receptor.

Figure 2 lists nucleotide bases 1 to 300 in the above mentioned species, which include coding regions for the above mentioned amino acid sequences present in Figure 1.

Figure 3 lists amino acids 200 to 300 of TSH receptors in the above mentioned species, which include the following amino acid sequences employed in the present invention:

amino acids 246 to 260 of a TSH receptor; and
amino acids 247 to 260 of a TSH receptor.

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Figure 4 lists nucleotide bases 700 to 899 in the above mentioned species, which include coding regions for the above mentioned amino acid sequences present in Figure 3.

Figure 5 lists amino acids 250 to 449 of TSH receptors in the above mentioned species,
5 which include the following amino acid sequences employed in the present invention:

amino acids 260 to 363 of a TSH receptor; and
amino acids 277 to 296 of a TSH receptor.

10 Figure 6 lists nucleotide bases 750 to 1100 in the above mentioned species, which include coding regions for the above mentioned amino acid sequences present in Figure 5.

Figure 7 lists amino acids 350 to 500 of TSH receptors in the above mentioned species,
which include the following amino acid sequences employed in the present invention:

15 amino acids 380 to 418 of a TSH receptor; and
amino acids 381 to 385 of a TSH receptor.

Figure 8 lists nucleotide bases 1100 to 1299 in the above mentioned species, which
20 include coding regions for the above mentioned amino acid sequences present in Figure 7.

Example 1

25 (1) Production of mouse monoclonal antibodies to the TSH receptor

BALB/c mice were immunised with a recombinant, highly purified mature form of the TSH receptor expressed in CHO cells. [Y Oda, J Sanders, M Evans, A Kiddie, A Munkley, C James, T Richards, J Wills, J Furmaniak, B Rees Smith "Epitope analysis
30 of the human thyrotrophin (TSH) receptor using monoclonal antibodies." Thyroid 2000 10(12): 1051-1059.] Mouse antibodies were also raised by DNA immunisation technique

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with full length human TSHR cDNA cloned in pcDNA3.1. MAbs were cloned using standard techniques and IgGs were purified from culture supernatants by affinity chromatography on Protein A Sepharose. The reactivity of MAbs with the TSH receptor was tested by (a) Western blotting with partially purified receptors, (b) inhibition of TSH binding to the TSH receptor, and (c) immunoprecipitation of ^{35}S -labelled TSH receptors produced in an *in vitro* transcription/translation system as described in Y Oda, J Sanders, S Roberts, M Maruyama, R Kato, M Perez, VB Peteresen, N Wedlock, J Furmaniak, B Rees Smith "Binding characteristics of antibodies to the TSH receptor." Journal of Molecular Endocrinology 1998 20: 233-244.

(2) Inhibition of ^{125}I -TSH binding to the TSH receptor

The inhibition of ^{125}I -TSH binding to the TSH receptor was analysed in an assay where, 50 μL of detergent solubilised TSH receptor was preincubated with 50 μL of MAb purified as described in step (1) for 15 minutes at room temperature before addition of 100 μL of ^{125}I -TSH (30,000cpm) followed by incubation at 37°C for one hour. The complexes of ^{125}I -TSH/TSH receptor were precipitated by addition of 2mL 16.5% polyethylene glycol and 25 μL healthy blood donor serum, centrifuged at 1500xg for 30 minutes at 4°C, aspirated and the radioactivity of the pellets counted using known techniques.

MAbs termed: 2B4 MAb (at IgG concentration of 5 $\mu\text{g}/\text{mL}$), 8E2 MAb (at IgG concentration of 1 $\mu\text{g}/\text{mL}$) and 18C5 MAb (at IgG concentration 1mg/mL) showed 76%, 38% and 91% inhibition of TSH binding, respectively. Fab fragments were produced from 2B4 MAb, 8E2 MAb and 18C5 MAb IgGs by digestion with L-cysteine/papain or pepsin, followed by the separation of Fc and Fab on Protein A column.

(3) Epitope recognition by MAbs

Western blotting analysis [Y Oda, J Sanders, M Evans, A Kiddie, A Munkley, C James, T Richards, J Wills, J Furmaniak, B Rees Smith "Epitope analysis of the human thyrotrophin (TSH) receptor using monoclonal antibodies." Thyroid 2000 10(12): 1051-

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1059.] showed that 2B4 MAb bound to an epitope between amino acid (aa) 380 and 418, 8E2 MAb to an epitope between aa 22 and 91 and 18C5 MAb to an epitope between aa 246 and 260 of the TSH receptor sequence. Analysis with overlapping TSH receptor peptides covering these regions [Y Oda, J Sanders, M Evans, A Kiddie, A Munkley, C James, T Richards, J Wills, J Furmaniak, B Rees Smith "Epitope analysis of the human thyrotrophin (TSH) receptor using monoclonal antibodies." Thyroid 2000 10(12): 1051-1059.] showed that 2B4 MAb reacted with the aa 381 to 385, 8E2 MAb with the aa 36 to 42 and 18C5 MAb with the aa 247 to 260.

10 (4) Preparation of ^{125}I -labelled TSH receptor

Solubilised preparations of TSH receptor were labelled with ^{125}I by way of ^{125}I -labelled MAB (4E31) reactive with the C-terminal end of the TSH receptor prepared as described in J Sanders, Y Oda, S Roberts, A Kiddie, T Richards, J Bolton, V McGrath, S Walters, D Jaskólski, J Furmaniak, B Rees Smith "The interaction of TSH receptor autoantibodies with ^{125}I -labelled TSH receptor." Journal of Clinical Endocrinology and Metabolism 1999 84(10):3797-3802. Aliquots of ^{125}I -labelled 4E31 F(ab)₂ were incubated for 15 minutes at room temperature with solubilised TSH receptor and then used in an immunoprecipitation assay as described in step (5).

20 (5) Inhibition of TSH receptor autoantibody (TRAb) binding to the TSH receptor by MAbs

The inhibition of TRAb binding to the TSH receptor by MAbs was tested as follows:

25 10 μL of ^{125}I -labelled TSH receptor (30,000cpm) prepared in step (4) was preincubated with 20 μL of 2B4 Fab (5 and 10mg/mL) for 15 minutes at room temperature followed by incubation with 20 μL of TRAb positive patient serum for one hour at room temperature. 50 μL of solid phase Protein A (an anti-human IgG reagent) was then added and
30 incubation continued for one hour at room temperature followed by washing step and centrifugation at 1500xg at 4°C for 30 minutes, aspiration and counting of the

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radioactivity of the pellets. Similar experiments were carried out with 8E2 and 18C5 Fabs and the combination of two Fabs together.

Results of Example 1

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Results of the inhibition of TRAb binding to the TSH receptor are shown in Table 1.

Example 2

10 Methods

(1) Production of mouse monoclonal antibodies to the TSH receptor

BALB/C mice were immunised with a recombinant, highly purified mature form of the TSH receptor expressed in CHO cells (Y. Oda, J. Sanders, M. Evans, A. Kiddie, A. Munkley, C. James, T. Richards, J. Wills, J. Furmaniak, B. Rees Smith "Epitope analysis of the human thyrotropin (TSH) receptor using monoclonal antibodies" Thyroid 2000 10(12):1051-1059). Mouse antibodies were also raised by DNA immunisation techniques with full length human TSHR cDNA cloned in pRC/CM.1. MAbs were cloned using standard techniques and IgGs were purified from culture supernatants by affinity chromatography on Protein A Sepharose.

(Fab)₂ fragments were produced from the purified MAb IgGs by digestion with pepsin followed by chromatography on a protein A affinity column as described in Y. Oda, J. Sanders, S. Roberts, M. Maruyama, R. Kato, M. Perez, VB Petersen, N. Wedlock, J. Furmaniak, B. Rees Smith 1998 "Binding characteristics of antibodies to the TSH receptor". Journal of Molecular Endocrinology 20: 233-244.

Fab fragments were prepared by digestion of the purified MAbs with papain as described in E. Hendry, G. Taylor, F. Grennan-Jones, A. Sullivan, N. Liddy, J. Godfrey, N. Hayakawa, M. Powell, J. Furmaniak, B Rees Smith 2001 "X-ray crystal structure of a monoclonal antibody that binds to a major autoantigenic epitope on thyroid peroxidase."

Thyroid 11(12): 1091-1099.

The reactivity of MAbs with the TSH receptor was tested by (a) western blotting with partially purified receptors, (b) inhibition of the TSH binding to the TSH receptor and (c) immunoprecipitation of ³⁵S-labelled TSH receptors produced in an *in vitro* transcription/translation system as described in Y. Oda, J. Sanders, S. Roberts, M. Maruyama, R. Kato, M. Perez, VB. Petersen, N. Wedlock, J. Furmaniak, B. Rees Smith "Binding characteristics of antibodies to the TSH receptor" Journal of Molecular Endocrinology 1998 20: 233-244.

(2) Inhibition of ¹²⁵I TSH binding to the TSH receptor

(a) PEG method for use with detergent solubilised TSHR

The inhibition of ¹²⁵I TSH binding to detergent solubilised TSH receptor was analysed in an assay where 50 µl of MAb purified as described in Methods (1) above was preincubated with receptor for 15 minutes at room temperature before addition of 100 µl of ¹²⁵I TSH (30,000 cpm) followed by incubation at 37°C for one hour. The complexes of ¹²⁵I TSH and TSH receptor were precipitated by addition of 2 mL 16.5% polyethylene glycol and 25 µL healthy blood donor serum, centrifuged at 1500 x g for 30 minutes at 4°C, aspirated and the radioactivity of the pellets counted in a gamma counter.

(b) Method using tubes coated with TSHR

In this procedure, plastic tubes are first coated with a MAb such as 4E31 which binds to a part of the TSHR unrelated to TSH or TRAb binding. Detergent solubilised TSHR preparations are then added, captured by the TSHR MAb and then become immobilised on the tube surface in such a way as to be able to bind TSH or TRAb. In particular the MAb 4E31 reactive with the TSHR C terminus (10 µg/mL F(ab)₂ preparation in 0.1 M Na₂CO₃ pH 9.2) was added to plastic tubes (Nunc Maxisorp, 200 µL per tube) and coating allowed to proceed overnight at 4°C. After washing and post-coating (10 mg/mL bovine

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serum albumin) the tubes were washed again with assay buffer (10 mM Tris-HCl pH 7.8, 50 mM NaCl, 1 mg/mL bovine serum albumin, 0.1% Triton X-100). 200 μ L of a detergent solubilised TSHR preparation was then added and incubated overnight at 4°C followed by aspiration and washing steps. Thereafter, 20 μ L of "start" buffer (10 mM Tris-HCl pH 7.8, 50 mM NaCl, bovine serum albumin 1 mg/mL, 6mM NaN₃, 1% Triton X-100) was added to the TSHR coated tubes followed by 100 μ L of purified MAb IgG or patient sera and incubated at room temperature for 2 hours with gentle shaking. After aspiration, the tubes were washed twice with 1 mL of assay buffer before addition of 100 μ L of ¹²⁵I TSH (80,000 cpm) and incubation at room temperature for 20-60 min with shaking. The tubes were then washed twice with 1 mL of assay buffer, aspirated and counted in a gamma counter.

(3) Analysis of thyroid stimulating or blocking activities of MAbs.

The ability of MAbs to either stimulate the production of cyclic AMP in isolated porcine thyroid cells (thyroid stimulating activity) or to act as TSH antagonists by blocking TSH stimulation of cyclic AMP (blocking activity) was assessed using reagents from Yamasa Corporation, Tokyo, Japan.

In addition the ability of the MAbs to stimulate production of cyclic AMP in Chinese hamster ovary (CHO) cells expressing human TSHR was analysed as described by M. Kita, L. Ahma, R.C. Mariani, H. Vlasse, P. Unger, P.N. Graves, T. F. Davies 1999 "Regulation and transfer of a murine model of thyrotropin receptor antibody mediated Graves' disease." Endocrinology 140: 1392-1398.

(4) Binding of ¹²⁵I-labelled MAbs to the TSHR and effect of TRAb

Purified IgG from two of the MAbs that showed thyroid stimulating activity (16E5 and 14D3, table 2) were labelled with ¹²⁵I followed by separation of unincorporated ¹²⁵I by filtration on Sephadex G-50 as in (4) in Example 1.

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Plastic tubes were coated with TSHR preparations as in 2b above. Thereafter, 100 μ L of test serum (from healthy blood donors or from patients with Graves' disease) were added and tubes incubated for 2 hours at room temperature with shaking. After this incubation, the tubes were washed 2 times with assay buffer. Then, 100 μ L of 125 I-labelled 16E5 or 14D3 IgG (30,000 cpm diluted in 20 mM Tris-HCl pH 7.3, 50 mM NaCl, 1 mg/mL bovine serum albumin, 0.1% Triton X-100) was added to the tubes and incubated for 1 hour at room temperature with shaking. The tubes were then washed twice with the same buffer that was used for diluting 125 I-labelled MAbs and counted in a gamma counter.

10 (5) Binding of TSHR to MAb coated tubes and effect of TRAb

Detergent solubilised TSHR preparations (20 μ L) were incubated for 1 hour at room temperature with 100 μ L of test serum and 20 μ L of start buffer (2b above). 100 μ L of this mixture was then added to plastic tubes coated with TSHR MAb (as in 2b above) and incubated for 1 hour with shaking at room temperature. Then the tubes were aspirated and washed twice (2b above) and 100 μ L (30,000 cpm) of 125 I-labelled C-terminal TSHR MAb 4E31 F(ab)₂ preparation labelled with 125 I as in 4 above added. After further incubation for 1 hour at room temperature with shaking, the tubes were aspirated, washed twice and the radioactivity counted with a gamma counter.

20 Oligonucleotide primers were designed using the sequences as described previously (Kettleborough C.A. et al "Optimization of primers for cloning libraries of mouse immunoglobulin genes using the polymerase chain reaction." European Journal of Immunology 1993 23:206-211).

25 Both sense and antisense primers included additional 5' restriction endonuclease site sequences to facilitate cloning of PCR products. RT-PCR products were cloned into pUC18 DNA prepared by the Qiagen method (Qiagen) and sequenced by the Sanger-Coulson method.

30

Results of Example 2

- (1) Thyroid stimulating activity of the TSHR MABs is shown in tables 2 and 3. Four of the MABs (16E5, 14D3, 17D2, and 4D7) were able to stimulate cyclic AMP production in isolated porcine thyroid cells. In addition when Fab fragments from three of these MABs were tested, all three also stimulated cyclic AMP production (table 2). For comparison a TRAb positive patient serum showed similar levels of stimulation to the MABs (table 2). Also, TSHR MAb 2B4 which has the ability to inhibit TSH binding to the TSHR strongly did not show thyroid stimulating activity (table 2). Another TSHR MAb and Fab (3B3) did not stimulate cyclic AMP production nor did the Tg MAb Fab 2G2 (table 2).

In a further series of experiments some of the MABS which were able to stimulate porcine thyroid cells (16E5 and 14D3) were tested for their ability to stimulate cyclic AMP production in CHO cells expressing human TSHR (table 3). Similar results were obtained to those observed with porcine thyroid cells.

- (2) In the presence of sera from healthy blood donors, ^{125}I -labelled 16E5 bound to TSHR coated tubes is in the range from 23 to 35% of total counts added (table 4). In the presence of sera from patients with Graves' disease (all TRAb positive) the binding of ^{125}I -labelled 16E5 was markedly reduced and was in the range from 1.9 to 7.5% (table 4).

This indicated that Graves' disease patient sera with TRAb activity inhibit the binding of TSHR MAb 16E5 to the TSHR. Further experiments with labelled 16E5 are shown in table 5 where a comparison of the effects of Graves' disease patient sera on (a) ^{125}I -labelled 16E5 to TSHR coated tubes and (b) ^{125}I -labelled TSH binding to TSHR coated tubes. Similar experiments to those shown in table 5 were carried out with ^{125}I -labelled TSHR MAb 14D3 and the results are shown in table 6.

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The effects of Graves' disease patient sera on TSHR coated tube binding by ^{125}I -labelled 16E5, 14D3 or TSH were similar with strong inhibition of binding being observed in most cases (tables 5 and 6). In contrast to Graves' disease patient sera, sera from healthy blood donors had little effect on labelled MAb or labelled TSH binding to TSHR coated tubes (tables 5 and 6). Table 7 shows the effect of sera containing autoantibodies other than the TSHR autoantibodies on TSHR coated tube binding by labelled TSH, 16E5 and 14D3. As can be seen from table 7, sera containing autoantibodies to glutamic acid decarboxylase (D1 and D2) or to 21-hydroxylase (A1 and A2) had no effect on TSH or MAb binding. However, the serum G42 from a patient with Graves' disease showed a strong, dose-dependent inhibition of both TSH and MAb binding.

- (3) As shown in table 8, plastic tubes coated with MAb 16E5 were able to bind TSHR and this binding was inhibited by Graves' sera containing TSHR autoantibodies. In particular, detection of TSHR binding by the ^{125}I -labelled TSHR MAb 4E31 showed that (a) in the presence of sera from healthy blood donors, labelled 4E31 binding ranged from 13.5-17.8% of total cpm added whereas (b) in the presence of Graves' sera, labelled MAb binding ranged from 1.8-4.8% of total cpm added. Similar results were obtained with plastic tubes coated with MAb 14D3 (table 9).

Conclusions

The results shown in tables 2 - 9 show:

- (a) we have produced TSHR MAbs and MAb Fab fragments which can stimulate isolated thyroid cells in a similar way to TRAb in patient sera and in a similar way to TSH. Different MAbs show different degrees of stimulating activity.
- (b) these MAbs can be used instead of labelled TSH in assays for TSHR autoantibodies (TRAb).

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- (c) when the MAbs are coated onto plastic surfaces, they can bind TSHR preparations. This binding is inhibited by TRAb in patient sera, thus providing a new type of TRAb assay.
- 5 (d) the ability of the MAbs to stimulate the thyroid means that they are potentially useful as alternatives to TSH in *in vivo* applications.

Example 3

10 Inhibition of ^{125}I -16E5 Fab binding to solubilised TSH receptor by TSH receptor MAbs

Method

The inhibition of ^{125}I -16E5 Fab binding to detergent solubilised TSH receptor was
15 analysed in an assay where 50 μl of Mab IgG (100 $\mu\text{g}/\text{ml}$) purified as described above was incubated with receptor for 30 minutes at room temperature before addition of 100 μl of ^{125}I -16E5 Fab (30,000 cpm) followed by incubation at room temperature for 2 hours. The complexes of ^{125}I -16E5 Fab and TSH receptor were precipitated by addition of 2ml 16.5% polyethylene glycol and 50 μl healthy blood donor serum, centrifuged at 1500 x g for 30
20 minutes at 4°C, aspirated and the radioactivity of the pellets counted in a gamma counter.

The results are shown in Table 10. From Table 10 it can be seen that Mab 4D7 (which binds to epitope region 246 to 260 and stimulates isolated thyroid cells) quite strongly inhibits labelled 16E5 Fab binding to the TSH receptor (24.2% inhibition). Two other
25 MAbs, 3C7 and 18C5 also quite strongly inhibit 16E5 Fab binding (17 and 15.7% inhibition respectively) and also bind to the epitope region 246 to 260. Weak or no inhibition is observed with the other MAbs. This suggests that epitope region 246 to 260 is involved in 16E5 binding to the TSH receptor. As the other stimulating MAbs 14D3 and 17D2 compete well with 16E5 binding to the TSH receptor as can be seen from Table
30 10, epitope region 246 to 260 is probably also important for TSH receptor binding by 14D3 and 17D2.

Table 1: Inhibition of binding of TRAb in patient serum (K3) to the TSH receptor by MAb Fabs.

5	Serum K3 1/10	
	Labelled TSHR immunoprecipitated (%)	% inhibition
	Buffer	17.5
	2B4 (5mg/ml)	42
	2B4 (10mg/ml)	77.7
	18C5 (5mg/ml)	21.7
10	18C5 (10mg/ml)	44
	8E2 (5mg/ml)	14.3
	8E2 (10mg/ml)	25.7
	2B4 + 18C5 (5mg/ml)	67.4
15	18C5 + 8E2 (5mg/ml)	29.1
	2B4 + 8E2 (5mg/ml)	53.7
20	Unlabelled TSH (2.94mg/ml)	55.4
	2B4+8E2+18C5 (3.3mg/ml)	57.7

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

25 A = ^{125}I -TSHR (cpm) immunoprecipitated in the presence of test sera and test Mab Fab as a percentage of total cpm of material added to the tube

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B = ^{125}I -TSHR (cpm) immunoprecipitated in the presence of test sera and assay buffer as a percentage of total cpm of material added to the tube

The above results show that:

5

(1) the sequences of the TSH receptor which are involved in the TSH binding are also involved in TRAb binding;

10

(2) mouse MAb reactive with these sequences can be used effectively to inhibit TRAb binding to the TSH receptor; and

(3) one or more of the MAbs reactive with one or more of the above TSH receptor sequences can be used to detect and measure TRAb.

Table 2: Thyroid stimulating activity of TSHR MAbs tested using isolated porcine thyroid cells

Test sample	Stimulation (%) ¹	Inhibition of TSH binding (%) ^{2,3}
16E5 IgG 200 µg/ml	466	nt
20 µg/ml	332	83.3
2 µg/ml	269	73.6
0.2 µg/ml	157	nt
0.02 µg/ml	52	nt
14D3 IgG 200 µg/ml	557	nt
20 µg/ml	351	76.4
2 µg/ml	323	61.0
0.2 µg/ml	227	nt
0.02 µg/ml	78	nt
17D2 IgG 200 µg/ml	377	nt
20 µg/ml	207	81.3
2 µg/ml	134	73.7
4D7 IgG 200 µg/ml	259	33 ⁴
20 µg/ml	31	nt
3B3 IgG ^a 200 µg/ml	34	30.7
20 µg/ml	37	6.1
2B4 IgG ^a 20 µg/ml	100	nt
2 µg/ml	116	69.9
3C7 Fab 1 mg/ml	348	45.2
4D7 Fab 1 mg/ml	512	48.6
16E5 Fab 200 µg/ml	425	53 ⁵
14D3 Fab 200 µg/ml	648	64 ⁵
17D2 Fab 200 µg/ml	274	45 ⁵

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3B3 Fab^a 200 µg/ml	42	66.5 ⁴
2G2 Fab⁶ 1 mg/ml	55	0
200 µg/ml	37	0
TRAb +ve patient dil 1:2	771	65 ⁷
dil 1:4	530	nt
Pool of healthy blood donor sera	29	0.6
TRAb negative serum	70	0

Table 2 footnotes:

10 ¹ MAb IgG or Fab preparations were diluted in the pool of healthy blood donor sera. Stimulation (%) was calculated as 100x the ratio of: cyclic AMP produced in the presence of test sample to cyclic AMP produced in the presence of a pool of healthy blood donor sera. A stimulation level of > 180% was assessed as positive i.e. this level of stimulation was always greater than that observed by sera from individual healthy blood donors.

² Inhibition of TSH binding level of >10% is positive.

³ Method = coated tube.

⁴ Inhibition tested at 250 µg/ml.

⁵ Inhibition tested at 10 µg/ml.

25 ⁶ 2G2 is a MAb reactive with thyroglobulin i.e. unreactive with the TSHR.

⁷ Inhibition with undiluted serum.

^a 3B3 and 2B4 IgGs act as TSH antagonists i.e. block the ability of TSH to stimulate cyclic AMP production by isolated porcine thyroid cells.

nt = not tested at this concentration.

Table 3: Thyroid stimulating activity of TSHR MAbs tested using CHO cells expressing human TSHR

Test Sample ¹	Stimulation (%) ²	Inhibition of TSH binding (%) ^{3,4}
16E5 20µg/ml	850	78.8 ⁵
14D3 20µg/ml	908	71.8 ⁵
2B4 20µg/ml	111	84.4
TRAb+ve patient	850	65.0 ⁶
Pool of healthy blood donor sera	100	0

Table 3 footnotes:

¹ All samples were diluted 1:10 prior to addition to cells.

² Stimulation (%) was calculated as 100x the ratio of: cyclic AMP produced in the presence of test sample to cyclic AMP produced in the presence of a pool of healthy blood donor sera.

³ Inhibition of TSH binding level of >10% is positive.

⁴ Method = coated tubes

⁵ Inhibition tested at 10 µg/ml

⁶ Tested for inhibition undiluted.

Table 4: Binding of ^{125}I -labelled MAb 16E5 to TSHR coated tubes and effect of TRAb in patient sera

Test material ¹	Inhibition of TSH binding (%) ²	^{125}I -16E5 bound to TSHR coated tubes (%total counts added)
G1	21	5.6
G2	22.7	6.5
G3	24.7	3.5
G4	22.7	6.0
G5	28.1	3.6
G6	29.4	2.5
G7	29.3	5.8
G8	39	1.9
G9	31.9	6.8
G10	34.8	5.4
G11	34.5	3.4
G12	35.3	4.2
G13	35.6	6.2
G14	36.9	2.8
G15	30.3	4.3
G16	35	2.2
G17	47.6	3.9
G18	44.3	3.4
G19	53.5	3.7
G20	59.2	7.5
G21	58.9	4.9
NPS	<14	27.5
NSF 1	<14	23.3
NSF 2	<14	30.2
NSF 3	<14	29.1

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NSF 4	<14	22.8
NSF 5	<14	28.9
NSF 6	<14	31.0
NSF 7	<14	29.2
NSF 8	<14	35.3
NSF 9	<14	26.3
NSF 10	<14	25.2

Table 4 Footnotes:

10 ¹ sera G1-G22 are from patients with Graves' disease; sera NSF 1 - NSF 10 are from healthy blood donors;
NPS = pool of healthy blood donor sera

² Inhibition of TSH binding >14% is positive; PEG method used.

Table 5: Effect of Graves' disease patient sera on ^{125}I -16E5 binding and ^{125}I -TSH binding to TSHR coated tubes

Test material ¹	^{125}I -16E5 bound to TSHR coated tubes (% total counts added) ²	Inhibition of ^{125}I -16E5 binding (%) ^{3,3}	^{125}I -TSH bound to TSHR coated tubes (% total counts added) ⁴	Inhibition of ^{125}I TSH binding (%) ^{3,4}
G23	13.2	44.0	8.9	27.1
G28	5.8	75.4	3.8	68.5
G29	13.3	43.6	8.0	34.4
G30	9.2	61.0	5.3	56.9
G32	11.9	49.6	7.5	38.4
G36	15.5	34.3	10.1	17.5
G38	16.1	31.8	10.0	18.3
G41	17.8	24.6	10.8	11.4
G43	5.9	75.0	4.0	67.2
G44	18.6	21.2	12.4	-ve
G45	5.1	78.4	3.5	71.0
G46	3.8	83.9	2.7	77.9
G47	7.2	69.5	4.3	64.8
G48	6.9	70.8	4.8	60.8
G49	9.1	61.4	6.1	49.6
G50	8.7	63.1	6.3	48.4
G51	11.9	49.6	7.9	35.2
G52	12.3	47.9	7.4	39.0
NSF 4	23.0	2.6	12.5	-ve
NSF 5	25.3	-ve	12.3	-ve
NSF 10	22.4	5.1	12.5	-ve
NSF 16	23.3	1.3	12.0	1.8
NSF 17	24.2	-ve	11.5	5.3
NSF 18	19.9	15.7	11.2	8.0
NSF 20	21.5	8.9	12.3	-ve

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NSF 21	23.3	1.3	12.3	-ve
NSF 22	24.5	-ve	12.4	-ve
NSF 26	26.5	-ve	12.8	-ve

5 Table 5 footnotes:

1 Sera G23-G52 are from patients with Graves' disease;
sera NSF are from healthy blood donors

2 mean binding in the presence of healthy blood donor sera was 23.6% for ¹²⁵I-16E5.

10

3 inhibition of binding was calculated using the formula

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

where A= binding in the presence of test serum;

B= mean binding in the presence of healthy blood donor sera

15

4 mean binding in the presence of healthy blood donor sera was 12.2% for ¹²⁵I-TSH.

Table 6: Binding of ^{125}I -labelled MAb 14D3 to TSHR coated tubes and effect of TRAb in patient sera

Test material ¹	^{125}I -14D3 bound to TSHR coated tubes (%total counts added) ²	Inhibition of ^{125}I -14D3 binding (%) ^{2,3}	^{125}I -TSH bound to TSHR coated tubes (% total counts added) ⁴	Inhibition of ^{125}I TSH binding (%) ^{3,4}
G23	13.9	20	8.9	26.6
G24	11.3	35	6.9	43.4
G25	14.1	19	7.2	40.5
G26	7.3	58	2.6	78.3
G27	12.3	29.7	7.3	40.1
G28	8.0	54.4	3.8	68.3
G29	13.2	24.4	8.0	34.0
G30	12.5	28.4	5.3	56.6
G31	9.8	44	4.3	64.3
G32	11.4	34.8	7.5	38.0
G33	12.7	27.2	6.1	49.9
G34	10.9	37.5	7.5	37.8
G35	9.8	43.6	4.3	64.6
G36	13.5	22.8	10.1	16.9
G37	11.9	31.6	9.3	23.4
G38	11.3	35.4	10.0	17.6
G39	12.3	29.5	7.9	34.8
G40	9.8	44.0	7.2	40.9
G41	14.0	19.8	10.8	10.7
NSF 4	17.4	0.3	12.5	-ve
NSF 5	16.5	9.1	12.3	-ve
NSF 10	17.6	-ve	12.5	-ve
NSF 16	17.7	-ve	12.0	1.1
NSF 17	17.0	2.7	11.5	4.6

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NSF 18	16.6	8.6	11.2	7.3
NSF 20	18.3	-ve	12.3	-ve
NSF 21	16.8	3.6	12.3	-ve
NSF 22	16.3	6.7	12.4	-ve
NSF 26	18.4	-ve	12.8	-ve

Table 6 footnotes:

¹ Sera G23-G41 are from patients with Graves' disease;
 sera NSF are from healthy blood donors

² mean binding in the presence of healthy blood donor sera was 17.4% for ¹²⁵I-14D3.

³ inhibition of binding was calculated using the formula

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

where A= binding in the presence of test serum;

B= mean binding in the presence of healthy blood donor sera

⁴ mean binding in the presence of healthy blood donor sera was 12.1% for ¹²⁵I-TSH.

Table 7: Effect of sera from various patients on TSHR coated tube binding by labelled TSH, 16E5 and 14D3

Test sample ¹	%inhibition of binding to TSHR coated tubes ² using:		
	¹²⁵ I-TSH	¹²⁵ I-16E5	¹²⁵ I-14D3
G42/5	87	71	77
G42/10	82	56	51
G42/20	70	34	24
D1/10	2	3	2
D1/100	-2	3	0
D2/10	1	1	-7
D2/100	-2	0	0
A1/10	-1	3	2
A1/100	-1	3	-1
A2/10	5	3	5
A2/100	1	3	1

Table 7 Footnotes :

¹ Serum G42 is from a patient with Graves' disease;

sera D1 and D2 are from patients with type 1 diabetes mellitus (positive for autoantibodies to glutamic acid decarboxylase)

sera A1 and A2 are from patients with Addison's disease (positive for steroid 21-hydroxylase autoantibodies)

All test samples were diluted in a pool of serum from healthy blood donors and dilution factor shown as /5, /10, /20 or /100

² inhibition of binding was calculated using the formula

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

where A= binding in the presence of test serum;

B= mean binding in the presence of a pool of healthy blood donor sera

Table 8: Effect of patient sera on binding of TSHR to 16E5 F(ab)₂ coated tubes

Test material ¹	¹²⁵ I-4E31 labelled TSHR bound to 16E5 F(ab) ₂ coated tubes (% total counts added)	Inhibition of TSHR binding ²	Inhibition of TSH binding (%) ³
G43	1.8	91.4	72.3
G44	4.8	77.2	45.1
G45	3.0	85.6	71.8
G46	2.0	90.2	83.8
G47	1.8	91.4	75.3
NSF 10	17.8	-15	<14
NSF 17	14.8	4	<14
NSF 21	13.5	12	<14

Table 8 footnotes:

¹ Sera G43-G47 are from patients with Graves' disease;
sera NSF are from healthy blood donors

² inhibition of binding was calculated using the formula

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

where A= binding 4E31 binding in the presence of test serum;

B= mean labelled 4E31 binding for healthy blood donor sera (15.4%)

³ inhibition of TSH binding >14% is positive; PEG method used.

Table 9: Effect of patient sera on binding of the TSHR to 14D3 F(ab)₂ coated tubes

Test material ¹	¹²⁵ I-4E31 labelled TSHR bound to 14D3 F(ab) ₂ coated tubes (% total counts added)	Inhibition of TSHR binding ²	Inhibition of TSH binding (%) ³
Serum A	4.0	70	72
Serum B	6.9	49	40
Serum C	3.0	78	85
Serum D	2.6	81	80
NSF 5	15.1	-12	<14
NSF 17	14.6	-9	<14
NSF 21	12.0	10	<14
NSF 23	11.8	12	<14

Table 9 footnotes:

¹ Sera A-D are from patients with Graves' disease;
sera NSF are from healthy blood donors

² inhibition of binding was calculated using the formula

$$\% \text{ inhibition} = 100 - \left(\frac{A}{B} \times 100 \right)$$

where A= labelled 4E31 binding in the presence of test serum;

B= mean labelled 4E31 binding for healthy blood donor sera (13.4%)

³ inhibition of TSH binding >14% is positive; PEG method used.

Table 10 Inhibition of ¹²⁵I-16E5 Fab binding to TSHR by TSHR MAbs

IgG (100µg/ml)	% inhibition	Epitope region (aa)
16E5	70.4	-
14D3	67.6	-
17D2	69.2	-
2G2	-ve	Thyroglobulin specific
5D6	-ve	22-41
8E2	-ve	22-41
4B5	7.1	22-41
10C4	-ve	37-56
10D5	-ve	37-71
4D2	-ve	37-71
2E2	-ve	52-71
1D6	-ve	202-221
7B5	-ve	202-221
16B6	-ve	202-221
3C3	11.2	202-236
4B4	-ve	217-236
4E4	-ve	217-236
8D3	-ve	217-236
6D7	-ve	217-236
18C5	15.7	246-260
3C7	17	246-260
4D7	24.2	246-260
3B3	8.8	277-296
5B5	-ve	307-326
4E6	-ve	307-326
6E2	-ve	322-341
9C2	-ve	322-341
6B4	-ve	337-356
3E4	-ve	337-371
3F3	-ve	352-371
3B2	-ve	352-371
7C2	-ve	367-386
2B4	-ve	381-385
3E6	5.4	381-385
8E3	4.8	381-385
7C4	-ve	381-385
1D5	4.2	381-385
4E2	-ve	381-385
3D3	-ve	382-401
2C4	-ve	382-401
10C2	-ve	382-401
7E5	-ve	382-401

CLAIMS

1. For use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence comprising part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact with said polypeptide sequence, so as to enable said diagnosis or therapy.

2. Use according to claim 1, wherein said polypeptide sequence comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments;

3. Use according to claim 1, wherein said polypeptide sequence comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments.

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4. For use in diagnosis or therapy of autoimmune disease associated with an immune reaction to a TSH receptor, a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7,

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact with said polypeptide sequence, so as to enable said diagnosis or therapy.

5. Use according to claim 4, wherein said polypeptide sequence comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments.

6. Use according to claim 4, wherein said polypeptide sequence comprises, consists

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of or consists essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments.

7. Use according to any of claims 1 to 6, wherein said polypeptide sequence comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;
amino acid numbers 36 to 42 of a TSH receptor;
amino acid numbers 247 to 260 of a TSH receptor;
amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor.

8. Use according to any of claims 1 to 7, employing:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments; and

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(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments;

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact with said polypeptide sequences, so as to enable said diagnosis or therapy.

9. Use according to claim 8, which further employs:

(iii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor, or variants, analogs or derivatives of such fragments.

10. Use according to any of claims 1 to 9, which employs:

(i) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more TSH receptor epitopes with which autoantibodies and / or

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lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments; and

(ii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments;

wherein autoantibodies and / or lymphocytes produced in response to a TSH receptor interact with said polypeptide sequences, so as to enable said diagnosis or therapy.

11. Use according to claim 10, which further employs:

(iii) a polypeptide sequence comprising, consisting of or consisting essentially of part or all of the primary structural conformation of one or more further TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said

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polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or variants, analogs or derivatives of such fragments.

12. Use according to any of claims 1 to 11, wherein said polypeptide sequence or sequences interact with autoantibodies produced in response to the TSH receptor, so as to enable said diagnosis or therapy.

13. Use according to any of claims 1 to 11, wherein said polypeptide sequence interacts with lymphocytes produced in response to the TSH receptor, so as to enable said diagnosis or therapy.

14. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;

amino acid numbers 246 to 260 of a TSH receptor;

amino acid numbers 260 to 363 of a TSH receptor; and

amino acid numbers 380 to 418 of a TSH receptor.

15. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or

fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
5 amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and
7

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16. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or
15 fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;
amino acid numbers 36 to 42 of a TSH receptor;
amino acid numbers 247 to 260 of a TSH receptor;
20 amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor.

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17. A TSH receptor epitope comprising, consisting of or consisting essentially of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants,
25 analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

25

18. A TSH receptor epitope comprising, consisting of or consisting essentially of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants,
30 analogs, derivatives or fragments thereof, or variants, analogs or derivatives of

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polypeptide sequence comprising, consisting of or consisting essentially of the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or variants, analogs or derivatives of such fragments.

12. Use according to any of claims 1 to 11, wherein said polypeptide sequence or sequences interact with autoantibodies produced in response to the TSH receptor, so as to enable said diagnosis or therapy.

13. Use according to any of claims 1 to 11, wherein said polypeptide sequence interacts with lymphocytes produced in response to the TSH receptor, so as to enable said diagnosis or therapy.

14. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;

amino acid numbers 246 to 260 of a TSH receptor;

amino acid numbers 260 to 363 of a TSH receptor; and

amino acid numbers 380 to 418 of a TSH receptor.

15. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or

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fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
5 amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and
7

10

16. One or more TSH receptor epitopes with which autoantibodies and / or lymphocytes produced in response to a TSH receptor interact, said one or more TSH receptor epitopes comprising, consisting of or consisting essentially of one or more of the following, or one or more variants, analogs, derivatives or
15 fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;
amino acid numbers 36 to 42 of a TSH receptor;
amino acid numbers 247 to 260 of a TSH receptor;
20 amino acid numbers 277 to 296 of a TSH receptor; and
amino acid numbers 381 to 385 of a TSH receptor.

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17. A TSH receptor epitope comprising, consisting of or consisting essentially of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

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18. A TSH receptor epitope comprising, consisting of or consisting essentially of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of

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such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

5 19. A TSH receptor epitope comprising, consisting of or consisting essentially of amino acid numbers 247 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

10 20. One or more TSH receptor epitopes according to any of claims 14 to 19, which interacts with autoantibodies produced in response to a TSH receptor.

21. One or more TSH receptor epitopes according to any of claims 14 to 19, which interacts lymphocytes produced in response to a TSH receptor.

15 22. A polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes
20 produced in response to a TSH receptor can interact, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

25 amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;

30 with which autoantibodies and / or lymphocytes produced in response to a TSH

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receptor can interact, with the exception of a full length TSH receptor.

23. A polypeptide according to claim 22, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments.
24. A polypeptide according to claim 22, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments.
25. A polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:
- amino acid numbers 22 to 91 of a TSH receptor;
amino acid numbers 246 to 260 of a TSH receptor;
amino acid numbers 260 to 363 of a TSH receptor; and
amino acid numbers 380 to 418 of a TSH receptor;
- as depicted in any one of the amino acid sequences of any of Figures 1, 3, 5 and 7, with which autoantibodies and / or lymphocytes produced in response to a TSH

receptor can interact, with the exception of a full length TSH receptor.

26. A polypeptide according to claim 25, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments.

27. A polypeptide according to claim 25, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments.

28. A polypeptide according to any of claims 22 to 27, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of one or more of the following, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments:

amino acid numbers 32 to 41 of a TSH receptor;

amino acid numbers 36 to 42 of a TSH receptor;

amino acid numbers 247 to 260 of a TSH receptor;

amino acid numbers 277 to 296 of a TSH receptor; and

amino acid numbers 381 to 385 of a TSH receptor;

with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

29. A polypeptide with which autoantibodies and / or lymphocytes produced in

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response to a TSH receptor can interact and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, with the exception of a full length TSH receptor.

30. A polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, with the exception of a full length TSH receptor.

31. A polypeptide with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact and which comprises, consists of or consists essentially of part or all of the primary structural conformation of one or more epitopes of a TSH receptor with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, which polypeptide comprises, consists of or consists essentially of the primary structural conformation of amino acid numbers 247 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or

derivatives of such fragments with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact, with the exception of a full length TSH receptor.

- 5 32. A polypeptide according to any of claims 22 to 31, which polypeptide comprises, consists of or consists essentially of:

10 (i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact; and

15 (ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH
20 receptor can interact.

33. A polypeptide according to claim 32, which further comprises:

25 (iii) the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH
30 receptor can interact.

34. A polypeptide according to any of claims 22 to 33, which polypeptide comprises,

consists of or consists essentially of:

(i) the primary structural conformation of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or one or more variants, analogs, derivatives or fragments of amino acid numbers 277 to 296 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 5, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact; and

(ii) the primary structural conformation of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or one or more variants, analogs, derivatives or fragments of amino acid numbers 246 to 260 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 3, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

35. A polypeptide according to claim 34, which further comprises:

(iii) the primary structural conformation of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or one or more variants, analogs, derivatives or fragments of amino acid numbers 381 to 385 of a TSH receptor as depicted in any one of the amino acid sequences of Figure 7, or variants, analogs or derivatives of such fragments, with which autoantibodies and / or lymphocytes produced in response to a TSH receptor can interact.

36. A polynucleotide comprising

- 5
- (i) a nucleotide sequence encoding a polypeptide according to any of claims 22 to 35;
- (ii) a nucleotide sequence encoding a polypeptide according to any of claims 22 to 35, which polypeptide comprises an amino acid sequence or sequences of specified amino acid numbers of a TSH receptor which is or are defined by reference to any of Figures 1, 3, 5 and 7;
- 10
- (iii) a nucleotide sequence encoding a polypeptide of (ii), which nucleotide sequence comprises nucleotide bases encoding the above mentioned specified amino acid numbers of a TSH receptor which are defined by reference to any of Figures 1, 3, 5, and 7, and which nucleotide bases are
- 15
- defined by reference to any of Figures 2, 4, 6 and 8;
- (iv) a nucleotide sequence differing from the sequence of (iii) in codon sequence due to the degeneracy of the genetic code;
- 20
- (v) a nucleotide sequence comprising an allelic variation of the sequence of (iii);
- (vi) a nucleotide sequence comprising a fragment of any of the sequences of (i), (ii), (iii), (iv) or (v); or
- 25
- (vii) a nucleotide sequence which hybridizes under stringent conditions to any of the sequences of (i), (ii), (iii), (iv), (v) or (vi).

37. A biologically functional plasmid which carries a polynucleotide according to claim 36, and which is capable of introducing the polynucleotide into the genome of a host organism.

30

38. A method of screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

5

(a) providing either (i) said sample of body fluid from said subject or (ii) lymphocytes isolated from said sample;

10

(b) contacting said sample or isolated lymphocytes with a polypeptide according to any of claims 22 to 35, so as to permit said polypeptide to interact with autoantibodies, or lymphocytes, produced in response to a TSH receptor, and present in, or isolated from, said sample; and

15

(c) monitoring the degree, or effect, of interaction of said polypeptide with either said autoantibodies, or said lymphocytes, produced in response to a TSH receptor and present in, or isolated from, said sample, thereby providing an indication of the presence of said autoantibodies, or said lymphocytes, in said sample, or isolated from said sample.

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39. A method according to claim 38, of screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from said subject.

40. A method according to claim 38, of screening for lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from said subject.

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41. A method according to claim 38, which comprises directly monitoring interaction of autoantibodies to a TSH receptor present in the sample of body fluid from the subject and a polypeptide according to any of claims 22 to 35, employing non-competitive sandwich type assay techniques.

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42. A method according to claim 38, which employs at least one competitor capable

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of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to any of claims 22 to 35.

43. A method according to claim 42, wherein said competitor comprises one or more antibodies.

44. A method of screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

(a) providing said sample of body fluid from said subject;

(b) contacting said sample with

(i) a full length TSH receptor, and

(ii) at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to any of claims 22 to 35,

so as to permit said full length TSH receptor to interact with either autoantibodies to a TSH receptor present in said sample, or said competitor; and

(c) monitoring the interaction of said full length TSH receptor with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

45. A kit for screening for autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from a subject suspected of

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suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

(a) a polypeptide according to any of claims 22 to 35;

(b) means for contacting either (i) a sample of body fluid obtained from said subject, or (ii) lymphocytes isolated from a sample of body fluid obtained from said subject, with said polypeptide according to any of claims 22 to 35, so as to permit said polypeptide to interact with autoantibodies, or lymphocytes, produced in response to a TSH receptor, and present in, or isolated from, said sample; and

(c) means for monitoring the degree, or effect, of interaction of said polypeptide with either said autoantibodies, or said lymphocytes, produced in response to a TSH receptor and present in, or isolated from, said sample, thereby providing an indication of the presence of said autoantibodies, or lymphocytes, in said sample or isolated from said sample.

46. A kit according to claim 45, for screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from said subject.

47. A kit according to claim 45, for screening for lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from said subject.

48. A kit according to claim 45, comprising means for directly monitoring interaction of autoantibodies to a TSH receptor present in the sample of body fluid from the subject and a polypeptide according to any of claims 22 to 35, comprising non-competitive sandwich type assay means.

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49. A kit according to claim 45, further comprising at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to any of claims 22 to 35 .

5 50. A kit according to claim 49, wherein said competitor comprises one or more antibodies.

10 51. A kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

(a) a full length TSH receptor;

15 (b) at least one competitor capable of competing with autoantibodies to a TSH receptor in the interaction thereof with a polypeptide according to any of claims 22 to 35;

20 (c) means for contacting said sample of body fluid from said subject, said full length TSH receptor and said competitor, so as to permit said full length TSH receptor to interact with either autoantibodies to a TSH receptor present in said sample, or said competitor; and

25 (d) means for monitoring the interaction of said full length TSH receptor with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

30 52. A method of diagnosing the likely onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in a subject suspected of suffering from, susceptible to, having or recovering from, autoimmune disease associated with an immune reaction to a TSH receptor, the method comprising

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detecting autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid from the subject according to any of claims 38 to 44, and whereby the detected autoantibodies and / or lymphocytes can provide a diagnosis of the likely onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in the subject.

53 . A method of delaying or preventing the onset of autoimmune disease associated with an immune reaction to a TSH receptor in an animal subject suspected of suffering from, susceptible to or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, which method comprises initially detecting autoantibodies or lymphocytes indicative of the onset or presence of autoimmune disease associated with an immune reaction to a TSH receptor in a sample of body fluid obtained from the subject according to any of claims 38 to 44, thereby providing a diagnosis of the likely onset of autoimmune disease associated with an immune reaction to a TSH receptor in the subject, and thereafter therapeutically treating the subject so as to delay the onset and / or prevent autoimmune disease associated with an immune reaction to a TSH receptor.

54. A polypeptide according to any of claims 22 to 35, for use in the therapeutic treatment of autoimmune disease associated with an immune reaction to a TSH receptor.

55. A pharmaceutical composition comprising a polypeptide according to any of claims 22 to 35, together with a pharmaceutically acceptable carrier, diluent or excipient therefor.

56. A polypeptide according to any of claims 22 to 35, for use in the manufacture of a medicament for the treatment of Graves' disease.

57. One or more therapeutic agents identified as providing a therapeutic effect by

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interaction with amino acids comprising part or all of the primary conformation of amino acids of one or more epitopes of a TSH receptor according to any of claims 14 to 21.

- 5 58. A method of treating autoimmune disease associated with an immune reaction to a TSH receptor in a subject, which method comprises initially detecting autoantibodies or lymphocytes produced in response to a TSH receptor in a sample of body fluid obtained from the subject according to any of claims 38 to 44, thereby providing a diagnosis of autoimmune disease in the subject, and
10 administering to the subject a therapeutically effective amount of at least one therapeutic agent effective in the treatment of such autoimmune disease.
59. A method according to claim 58, wherein said therapeutic agent comprises a polypeptide according to any of claims 22 to 35.
- 15 60. A method of treating autoimmune disease associated with an immune reaction to a TSH receptor in a subject, which method comprises administering to the subject a therapeutically effective amount of a therapeutic agent identified as providing a therapeutic effect by interaction with amino acids comprising part or all of the
20 primary conformation of amino acids of one or more epitopes of a TSH receptor according to any of claims 14 to 21.
61. A binding partner for a TSH receptor capable of interacting with amino acid numbers 277 to 296 of a TSH receptor.
- 25 62. A binding partner according to claim 61, which is a monoclonal or recombinant antibody.
- 30 63. A binding partner for a TSH receptor, which binding partner is capable of binding to a TSH receptor so as to stimulate the TSH receptor, which binding partner does not comprise TSH or naturally produced autoantibodies to the TSH receptor.

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64. A binding partner according to claim 63, which is a monoclonal antibody or fragment thereof.

65. A binding partner according to claim 64, which is a recombinant antibody or fragment thereof.

66. A binding partner according to any of claims 63 to 65, which interacts with one or more epitope regions according to any of claims 14 to 21.

67. A binding partner for a TSH receptor, which binding partner is capable of binding to the TSH receptor so as to stimulate the TSH receptor and which comprises:

an antibody V_H domain selected from the group consisting of:

V_H domains as shown in any one of Figures 10, 14, 18, 22, 42, 46 or 50, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 10, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 14, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 18, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 22, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 42, a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 46, and a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 50; and / or

an antibody V_L domain selected from the group consisting of:

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V_L domains as shown in any one of Figures 12, 16, 20, 24, 44, 48 or 52, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 12, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 16, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 20, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 24, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 44, a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 48, and a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 52.

68. A binding partner according to claim 67, comprising an antibody V_H domain as shown in Figure 10 paired with an antibody V_L domain as shown in Figure 12 to provide an antibody binding site, comprising both these V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 14 paired with an antibody V_L domain as shown in Figure 16 to provide an antibody binding site, comprising both these V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 18 paired with an antibody V_L domain as shown in Figure 20 to provide an antibody binding site comprising both these V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 22 paired with an antibody V_L domain as shown in Figure 24 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 42 paired with an antibody V_L domain as shown in Figure 44 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 46 paired with an antibody

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V_L domain as shown in Figure 48 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor; or comprising an antibody V_H domain as shown in Figure 50 paired with an antibody V_L domain as shown in Figure 52 to provide an antibody binding site comprising both V_H and V_L domains for a TSH receptor.

69. A binding partner according to claim 67, which comprises:

an antibody V_H domain comprising:

a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 10, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 14, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 18, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 22, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 42, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 46, or a V_H domain comprising one or more V_H CDRs with an amino acid sequence corresponding to a V_H CDR as shown in Figure 50; and / or

an antibody V_L domain comprising:

a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 12, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 16, or a V_L domain

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comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 20, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 24, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 44, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 48, or a V_L domain comprising one or more V_L CDRs with an amino acid sequence corresponding to a V_L CDR as shown in Figure 52.

70. A further binding partner capable of binding to the TSH receptor so as to stimulate the TSH receptor and which further binding partner can compete for binding to the TSH receptor with any specific binding partner according to any of claims 63 to 69, which further binding partner does not comprise TSH or autoantibodies to a TSH receptor.

71. A polynucleotide comprising:

(i) a nucleotide sequence as shown in any of Figures 25 to 40, or 53 to 64; or parts of such sequences as shown in Figures 26, 28, 30, 32, 34, 36, 38, 40, 54, 56, 58, 60, 62, or 64, encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR as shown in any of Figures 10, 12, 14, 16, 18, 20, 22, 24, 42, 44, 46, 48, 50 or 52;

(ii) a nucleotide sequence encoding a binding partner according to any of claims 63 to 70, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR of a binding partner according to any of claims 63 to 70;

(iii) a nucleotide sequence encoding a binding partner having a primary

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structural conformation of amino acids as shown in any of Figures 9 to 24 or 41 to 52, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR as shown in any of Figures 10, 12, 14, 16, 18, 20, 22, 24, 42, 44, 46, 48, 50 or 52;

5

(iv) a nucleotide sequence differing from any sequence of (i) in codon sequence due to the degeneracy of the genetic code;

10

(v) a nucleotide sequence comprising an allelic variation of any sequence of (i);

(vi) a nucleotide sequence comprising a fragment of any of the sequences of (i), (ii), (iii), (iv) or (v);

15

(vii) a nucleotide sequence differing from the any sequence of (i) due to mutation, deletion or substitution of a nucleotide base and encoding a binding partner according to any of claims 63 to 70, or encoding an amino acid sequence of an antibody V_H domain, an antibody V_L domain or CDR of a binding partner according to any of claims 63 to 70.

20

72. A biologically functional vector system which carries a polynucleotide according to claim 71 and which is capable of introducing the polynucleotide into the genome of a host organism.

25

73. A method of screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

30

(a) providing said sample of body fluid from said subject;

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(b) contacting said sample with

(i) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor, and

(ii) one or more binding partners according to any of claims 63 to 70;

so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding partners; and

(c) monitoring the interaction of said TSH receptor, said one or more epitopes thereof or said polypeptide, with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

74. A method according to claim 73, wherein said polypeptide is according to any of claims 22 to 35.

75. A method according to claim 73, wherein said one or more epitopes of a TSH receptor are according to any of claims 14 to 21.

76. A method according to any of claims 73 to 75, which comprises providing labelling means for said one or more binding partners according to any of claims 63 to 70.

77. A method of screening for autoantibodies produced in response to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from,

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susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said method comprising:

(a) providing said sample of body fluid from said subject;

(b) contacting said sample with

(i) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor, and

(ii) one or more binding members for a TSH receptor;

so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding members; and

(c) monitoring the interaction of said TSH receptor, said one or more epitopes thereof or said polypeptide, with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample;

wherein said one or more binding members are directly or indirectly immobilised to a surface either prior to, or after step (b)

78. A method according to claim 77, wherein said binding member comprises a binding partner as defined in any of claims 63 to 70.

79. A method according to claim 77, wherein said polypeptide is according to any of claims 22 to 35.

80. A method according to claim 77, wherein said one or more epitopes of a TSH receptor are according to any of claims 14 to 21.

5 81. A method according to claim 77, which comprises providing labelling means for said TSH receptor, said one or more epitopes thereof or said polypeptide.

10 82. A kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

(a) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor;

15 (b) one or more binding partners according to any of claims 63 to 70;

(c) means for contacting said sample of body fluid from said subject, said TSH receptor, said one or more epitopes thereof or said polypeptide, and said one or more binding partners, so as to permit said TSH receptor, said
20 one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding partners; and

(d) means for monitoring the interaction of said TSH receptor, said one or
25 more epitopes thereof or said polypeptide, with said autoantibodies present in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

30 83. A kit according to claim 82, wherein said polypeptide is according to any of claims 22 to 35.

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84. A kit according to claim 82, wherein said one or more epitopes of a TSH receptor are according to any of claims 14 to 21.

5 85. A kit according to claim 82, comprising labelling means for said one or more binding partners according to any of claims 63 to 70.

10 86. A kit for screening for autoantibodies to a TSH receptor in a sample of body fluid obtained from a subject suspected of suffering from, susceptible to, having or recovering from autoimmune disease associated with an immune reaction to a TSH receptor, said kit comprising:

(a) a full length TSH receptor, one or more epitopes thereof or a polypeptide comprising one or more epitopes of a TSH receptor;

15 (b) one or more binding members for a TSH receptor;

20 (c) means for contacting said sample of body fluid from said subject, said TSH receptor, said one or more epitopes thereof or said polypeptide, and said one or more binding members, so as to permit said TSH receptor, said one or more epitopes thereof or said polypeptide, to interact with either autoantibodies to a TSH receptor present in said sample, or said one or more binding members;

25 (d) means for directly or indirectly immobilising said one or more binding members to a surface, either before or after contacting said one or more binding members with said sample of body fluid from said subject and said TSH receptor, said one or more epitopes thereof or said polypeptide; and

30 (e) means for monitoring the interaction of said TSH receptor, said one or more epitopes thereof or said polypeptide, with said autoantibodies present

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in said sample, thereby providing an indication of the presence of said autoantibodies to a TSH receptor in said sample.

87. A kit according to claim 86, wherein said binding member comprises a binding partner as defined in any of claims 63 to 70.

88. A kit according to claim 86, wherein said polypeptide is according to any of claims 22 to 35.

89. A kit according to claim 86, wherein said one or more epitopes of a TSH receptor are according to any of claims 14 to 21.

90. A kit according to claim 86, comprising labelling means for said TSH receptor, said one or more epitopes thereof or said polypeptide.

91. A method of treating autoimmune disease associated with an immune reaction to a TSH receptor in a subject, comprising administering to said subject a therapeutically effective amount of a specific binding partner as defined in any of claims 63 to 70.

92. A pharmaceutical composition comprising a specific binding partner as defined in any of claims 63 to 70, together with one or more pharmaceutically acceptable carriers, diluents or excipients therefor.

93. Use of a specific binding partner as defined in any of claims 63 to 70, in the manufacture of a medicament for use in stimulating thyroid tissue, or tissue containing a TSH receptor.

94. Use of a specific binding partner as defined in any of claims 63 to 70, in the manufacture of a medicament for treatment of thyroid cancer.

95. A method of stimulating thyroid tissue, and / or tissue containing a TSH receptor, which method comprises administering to a patient in need of such stimulation a diagnostically or therapeutically effective amount of a binding partner as defined in any of claims 63 to 70.

5

96. In combination a binding partner as defined in any of claims 63 to 70, together with one or more further agents capable of stimulating thyroid tissue, and / or tissue containing a TSH receptor, for simultaneous, separate or sequential use in stimulating thyroid tissue, and / or tissue containing a TSH receptor.

10

97. A combination according to claim 96, wherein said one or more further agents comprise recombinant human TSH and / or one or more variants, analogs, derivatives or fragments thereof, or variants, analogs or derivatives of such fragments.

15

98. A combination according to claim 96, wherein said one or more further agents acts independently of binding to a TSH receptor.

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	MRPTPLLQLALLALPRSLGGKGCPSPPCECHQEEDDFRVT	Majority
1	MRPADLLQLVLLLDLPRDLGGMGCSSPPCECHQEEDDFRVT	HTSHR. PRO
1	MSLTPLLQLALVLALPRSLRGKGCPSPPCECHQEEDDFRVT	PTSHR. PRO
1	MRPTPLLRLALFLVLPSSLGGERCPSPCECRQEEDDFRVT	BTSHR. PRO
1	MRQTPLLQLALLLSLPRSLGGKGCPSPPCECHQEEDDFRVT	CTSHR. PRO
1	MRPPPLLHLALLLALPRSLGGKGCPSPPCECHQEEDDFRVT	DTSHR. PRO
1	MRPGSLLLLVLLLALSRLRGKECASPPCECHQEEDDFRVT	MTSHR. PRO
1	MRPGSLLQLTLLLALPRSLWGRGCTSPCECHQEEDDFRVT	RTSHR. PRO
1	MRPTPLLRLALLLVLPSSLWGERCPSPCECRQEEDDFRVT	STSHRP. PRO
	CKDIHRIPSLPPSTQTLKFIETHLKTIPSRAFSNLPNISR	Majority
41	CKDIQRIPSLPPSTQTLKLIETHLRTIPSHAFSNLPNISR	HTSHR. PRO
41	CKDIHSIPPLPPNTQTLKFIETHLKTIPSRAFSNLPNISR	PTSHR. PRO
41	CKDIQSIPSLPPSTQTLKFIETHLKTIPSRAFSNLPNISR	BTSHS. PRO
41	CKDIHRIPSLPPSTQTLKFIETHLKTIPSRAFSNLPNISR	CTSHR. PRO
41	CKDIHRIPTLPPSTQTLKFIETQLKTIPSRAFSNLPNISR	DTSHR. PRO
41	CKELHRIPSLPPSTQTLKLIETHLKTIPSLAFSSLPNISR	MTSHR. PRO
41	CKELHQIPSLPPSTQTLKLIETHLKTIPSLAFSSLPNISR	RTSHS. PRO
41	CKDIQRIPSLPPSTQTLKFIETHLKTIPSRAFSNLPNISR	STSHRP. PRO
	IYLSIDATLQQLESHSFYNLSKMTHIEIRNTRSLTYIDPG	Majority
81	IYVSIDVTLQQLESHSFYNLSKVTHIEIRNTRNLTYIDPD	HTSHR. PRO
81	IYLSIDATLQQLESQSFYNSKMTHIEIRNTRSLTYINPG	PTSHR. PRO
81	IYLSIDATLQQLESHSFYNLSKVTHIEIRNTRSLTYIDSG	BTSHR. PRO
81	IYLSIDATLQRLSHSFYNLSKMTHIEIRNTRSLTYIDPG	CTSHR. PRO
81	IYLSIDATLQRLSHSFYNLSKMTHIEIRNTRSLTSIDPD	DTSHR. PRO
81	IYLSIDATLQRLPHSFYNLSKMTHIEIRNTRSLTYIDPD	MTSHR. PRO
81	IYLSIDATLQRLPHSFYNLSKMTHIEIRNTRSLTYIDPD	RTSHR. PRO
81	IYLSIDATLQQLESHSFYNLSKVTHIEIRNTRSLTYIDSG	STSHRP. PRO
	ALKELPLLKFLGIFNTGLRVFPDLTKVYSTDVFFILEITD	Majority
121	ALKELPLLKFLGIFNTGLKMFPDLTKVYSTDIFFILEITD	HTSHR. PRO
121	ALKDLPLLKFLGIFNTGLRIFPDLTKVYSTDVFFILEITD	PTSHR. PRO
121	ALKELPLLKFLGIFNTGLRVFPDLTKIYSTDVFFILEITD	BTSHR. PRO
121	ALKELPLLKFLGIFNTGLGVFPDLTKVYSTDVFFILEITD	CTSHR. PRO
121	ALKELPLLKFLGIFNTGLGVFPDVTKVYSTDVFFILEITD	DTSHR. PRO
121	ALTELPLLKFLGIFNTGLRIFPDLTKIYSTDIFFILEITD	MTSHR. PRO
121	ALTELPLLKFLGIFNTGLRIFPDLTKIYSTDVFFILEITD	RTSHR. PRO
121	ALKELPLLKFLGIFNTGLRVFPDLTKIYSTDVFFILEITD	STSHRP. PRO
	NPYMTSIPANAFQGLCNETLTLKLYNNGFTSIQGHAFNGT	Majority
161	NPYMTSIPVNAFQGLCNETLTLKLYNNGFTSVQGYAFNGT	HTSHR. PRO
161	NPYMTSIPANAFQGLCNETLTLKLYNNGFTSVQGHAFNGT	PTSHR. PRO
161	NPYMTSIPANAFQGLCNETLTLKLYNNGFTSIQGHAFNGT	BTSHR. PRO
161	NPYMTSIPANAFQGLCNETLTLKLYNNGFTSIQGHAFNGT	CTSHR. PRO
161	NPYMASIPANAFQGLCNETLTLKLYNNGFTSIQGHAFNGT	DTSHR. PRO
161	NPYMTSVPENAFQGLCNETLTLKLYNNGFTSVQGHAFNGT	MTSHR. PRO
161	NPYMTSVPENAFQGLCNETLTLKLYNNGFTSIQGHAFNGT	RTSHR. PRO
161	NPYMTSVPANAFQGLSNETLTLKLYNNGFTSIQGHAFNGT	STSHRP. PRO

FIG. 1

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	ATGAGGCCGACGCCCCTGCTGCAGCTGGCGCTGCTTCTCG	Majority
1	ATGAGGCAGACGCCCCTGCTGCAGCTGGCGTTACTTCTCT	CAT.SEQ
1	ATGCGGCCGACGCCCCTCCTGCGGCTGGCGCTGTTTCTGG	COW.SEQ
1	ATGAGGCCGCCGCCCTGCTGCACCTGGCGCTGCTTCTCG	DOG.SEQ
1	ATGAGGCCAGGGTCCCTGCTGCTGCTTGTTCGCTGCTCG	MOUSE.SEQ
1	ATGAGTCTGACGCCCCTGTTGCAGCTGGCGCTCGTTCTCG	PTSHR.SEQ
1	ATGAGGCCAGGGTCCCTGCTCCAGCTCACTCTGCTGCTCG	RAT.SEQ
1	ATGCGGCCGACGCCCCTCCTGCGGTTGGCGCTGCTTCTGG	SHEEP.SEQ
1	ATGAGGCCGGCGGACTTGCTGCAGCTGGTGTGCTGCTCG	HTSHR.SEQ
	CCCTGCCCAGGAGCCTGGGGGGGAAGGGGTGTCCGTCTCC	Majority
41	CCCTGCCCAGGAGCCTGGGGGGGAAGGGGTGTCCGTCTCC	CAT.SEQ
41	TCCTGCCCAGCAGCCTCGGTGGGGAGAGGTGTCCGTCTCC	COW.SEQ
41	CCCTGCCCAGGAGCCTGGGGGGGAAGGGGTGTCCGTCTCC	DOG.SEQ
41	CCCTGTCCAGGAGCCTGCGGGGCAAGAGTGTGCGTCTCC	MOUSE.SEQ
41	CCCTGCCCAGGAGCCTCAGGGGGAAGGGGTGTCCGTCTCC	PTSHR.SEQ
41	CCCTGCCCAGGAGCCTCTGGGGGAGAGGTGTACTTCTCC	RAT.SEQ
41	TCCTGCCCAGCAGCCTCTGGGGGAGAGGTGTCCGTCTCC	SHEEP.SEQ
41	ACCTGCCCAGGAGCCTGGGCGGAATGGGGTGTTCGTCTCC	HTSHR.SEQ
	GCCCTGCGAGTGCCACCAGGAGGACGACTTCAGAGTCACC	Majority
81	GCCCTGCGAGTGTCACCAGGAAGATGACTTCAGAGTCACC	CAT.SEQ
81	GCCCTGCGAATGCCGCCAGGAGGACGACTTCAGAGTCACC	COW.SEQ
81	CCCCTGTGAGTGCCACCAGGAGGATGACTTCAGAGTCACC	DOG.SEQ
81	ACCCTGTGAGTGTCACCAGGAGGACGACTTCAGAGTCACC	MOUSE.SEQ
81	GCCCTGCGAATGCCACCAGGAGGACGACTTCAGAGTCACC	PTSHR.SEQ
81	ACCCTGCGAATGCCACCAGGAGGACGACTTCAGAGTCACC	RAT.SEQ
81	GCCCTGCGAATGCCGCCAGGAGGACGACTTCAGAGTCACC	SHEEP.SEQ
81	ACCCTGCGAGTGCCATCAGGAGGAGGACTTCAGAGTCACC	HTSHR.SEQ
	TGCAAGGATATCCACCGCATCCCCAGCTTACCGCCCAGCA	Majority
121	TGCAAGGATATTACCGTATCCCCAGCCTACCGCCCAGCA	CAT.SEQ
121	TGCAAGGACATCCAGAGCATCCCTAGCTTACCCCCAGCA	COW.SEQ
121	TGCAAGGATATCCACCGCATCCCCACCCTACCACCCAGCA	DOG.SEQ
121	TGCAAGGAGCTCCACCGAATCCCCAGCCTGCCGCCCAGCA	MOUSE.SEQ
121	TGCAAGGATATCCACAGCATCCCCCCTTACCACCCAATA	PTSHR.SEQ
121	TGCAAGGAACTCCACCAATCCCCAGCCTACCGCCCAGCA	RAT.SEQ
121	TGCAAGGACATCCAGCGCATCCCTAGCTTACCCCCAGCA	SHEEP.SEQ
121	TGCAAGGATATTCAACGCATCCCCAGCTTACCGCCCAGTA	HTSHR.SEQ
	CGCAGACTCTGAAGTTTATAGAGACTCATCTGAAAACCAT	Majority
161	CGCAGACTCTGAAATTTATAGAGACTCATCTGAAAACCAT	CAT.SEQ
161	CGCAGACCCTGAAGTTTATAGAGACTCATCTGAAAACCAT	COW.SEQ
161	CGCAGACTCTGAAGTTTATAGAGACTCAGCTGAAAACCAT	DOG.SEQ
161	CCCAGACTCTGAAGCTCATCGAGACTCATCTGAAGACCAT	MOUSE.SEQ
161	CTCAGACACTAAAGTTTATAGAGACTCATCTGAAAACCAT	PTSHR.SEQ
161	CCCAGACTCTGAAGCTCATCGAGACTCACCTGAAGACCAT	RAT.SEQ
161	CGCAGACCCTGAAGTTTATAGAGACTCATCTGAAAACCAT	SHEEP.SEQ
161	CGCAGACTCTGAAGCTTATTGAGACTCACCTGAGAACTAT	HTSHR.SEQ

FIG. 2

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	TCCCAGTCGTGCATTTTCAAATCTGCCCAATATTTCCAGG	Majority
201	TCCCAGTCGTGCATTTTCAAATCTGCCCAATATTTCCAGG	CAT.SEQ
201	TCCCAGTCGTGCGTTCTCAAATCTGCCCAATATTTCCAGG	COW.SEQ
201	TCCCAGTCGTGCATTTTCAAATCTGCCCAATATTTCCAGG	DOG.SEQ
201	ACCCAGTCTTGCATTTTTCGAGTCTGCCCAATATTTCCAGG	MOUSE.SEQ
201	CCCCAGTCGTGCATTTTCAAATCTGCCCAATATTTCCAGG	PTSHR.SEQ
201	TCCCAGTCTTGCCTTTTTCGAGCCTGCCCAATATTTCCAGG	RAT.SEQ
201	TCCCAGTCGTGCGTTCTCAAATTTGCCCAATATTTCCAGG	SHEEP.SEQ
201	TCCAAGTCATGCATTTTCTAATCTGCCCAATATTTCCAGA	HTSHR.SEQ
	ATCTACTTGTCAATAGATGCAACTCTGCAGCGGCTGGAAT	Majority
241	ATCTACTTGTCAATAGATGCAACTCTGCAGCGACTGGAAT	CAT.SEQ
241	ATCTACTTGTCAATAGATGCAACTCTGCAGCAGCTGGAAT	COW.SEQ
241	ATCTACTTGTCAATAGATGCAACTCTGCAGCGGCTGGAAT	DOG.SEQ
241	ATCTATTTATCTATAGATGCAACTCTGCAGCGGCTGGAAC	MOUSE.SEQ
241	ATCTACCTGTCAATAGATGCAACTCTACAGCAGCTGGAAT	PTSHR.SEQ
241	ATCTATCTATCCATAGATGCCACTCTGCAGCGACTGGAGC	RAT.SEQ
241	ATCTACTTGTCAATAGATGCGACTTTGCAGCAACTGGAAT	SHEEP.SEQ
241	ATCTACGTATCTATAGATGTGACTCTGCAGCAGCTGGAAT	HTSHR.SEQ
	CACATTCCTTCTACAATTTG	Majority
281	CACATTCCTTCTACAATTTG	CAT.SEQ
281	CACATTCCTTCTACAATTTA	COW.SEQ
281	CACATTCCTTCTACAATTTA	DOG.SEQ
281	CACATTCTTTCTACAATTTG	MOUSE.SEQ
281	CACAGTCCTTCTACAATTTG	PTSHR.SEQ
281	CACATTCTTTCTACAATTTG	RAT.SEQ
281	CACATTCCTTCTACAATTTA	SHEEP.SEQ
281	CACACTCCTTCTACAATTTG	HTSHR.SEQ

FIG. 2_{CONT'D}

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	TKLDAVYLNKNKYLTVIDKDAFGGVYSGFTLLDVSYTSVT	Majority
200	TKLDAVYLNKNKYLTVIDKDAFGGVYSGPSLLDVSQTSVT	HTSHR. PRO
200	TKLDAVYLNKNKYLTVIDKDAFGGVFSGPTLLDVSYTSVT	PTSHR. PRO
200	TKLDAVYLNKNKYLTVIDQDAFAGVYSGPTLLDISYTSVT	BTSHR. PRO
200	TKLDAVYLNKNKYLTVIDQDAFGGVYSGPTLLDVSYTSVT	CTSHR. PRO
200	TKLDAVYLNKNKYLSAIDKDAFGGVYSGPTLLDVSYTSVT	DTSHR. PRO
200	TKLDAVYLNKNKYLTVIDNDAFGGVYSGPTLLDVSSTSVT	MTSHR. PRO
200	TKLDAVYLNKNKYLTVIDKDAFGGVYSGPTLLDVSSTSVT	RTSHR. PRO
200	TKLDAVYLNKNKYLTVIDQDAFAGVYSGPTLLDISYTSVT	STSHRP. PRO
	ALPSKGLEHLKELIARNTWTLKKLPLSPSFLHLTRADLSY	Majority
240	ALPSKGLEHLKELIARNTWTLKKLPLSLSFLHLTRADLSY	HTSHR. PRO
240	ALPPKGLEHLKELIARNTWTLKKLPLSLSFLHLTRADLSY	PTSHR. PRO
240	ALPSKGLEHLKELIARNTWTLRKLPLSLSFLHLTRADLSY	BTSHS. PRO
240	ALPSKGLEHLKELIARNTWTLKKLPLTLSFLHLTRADLSY	CTSHR. PRO
240	ALPSKGLEHLKELIARNTWTLKKLPLSLSFLHLTRADLSY	DTSHR. PRO
240	ALPSKGLEHLKELIAKDTWTLKKLPLSLSFLHLTRADLSY	MTSHR. PRO
240	ALPSKGLEHLKELIAKNTWTLKKLPLSLSFLHLTRADLSY	RTSHS. PRO
240	ALPSKGLEHLKELIARNTWTLKKLPLSLSFLHLTRADLSY	STSHRP. PRO
	PSHCCAFKNQKKIRGILES LM	Majority
280	PSHCCAFKNQKKIRGILES LM	HTSHR. PRO
280	PSHCCAFKNQKKIRGILES LM	PTSHR. PRO
280	PSHCCAFKNQKKIRGILQSLM	BTSHR. PRO
280	PSHCCAFKNQKKIRGILES FM	CTSHR. PRO
280	PSHCCAFKNQKKIRGILES LM	DTSHR. PRO
280	PSHCCAFKNQKKIRGILES LM	MTSHR. PRO
280	PSHCCAFKNQKKIRGILES LM	RTSHR. PRO
280	PSHCCAFKNQKNIRGILQSLM	STSHRP. PRO

FIG. 3

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	TCTTACACCAGTGTCACTGCCCTTCCATCCAAAGGCCTGG	Majority
700	TCTTACACCAGTGTCACTGCCCTGCCATCCAAAGGCCTGG	CAT.SEQ
700	TCTTATACCAGTGTACAGCCCCTACCATCCAAAGGCCTGG	COW.SEQ
700	TCTTACACCAGTGTTACTGCCCTGCCATCCAAAGGCCTGG	DOG.SEQ
700	TCTTCCACCAGCGTCACTGCCCTTCCTTCCAAAGGCCTGG	MOUSE.SEQ
700	TCTTATACCAGTGTTACTGCCCTGCCACCCAAAGGCCTGG	PTSHR.SEQ
700	TCTTCCACCAGCGTACTGCTCTTCCTTCCAAAGGCCTGG	RAT.SEQ
700	TCTTATACCAGTGTCACTGCCCTACCATCCAAAGGCCTGG	SHEEP.SEQ
700	TCTCAAACCAGTGTCACTGCCCTTCCATCCAAAGGCCTGG	HTSHR.SEQ
	AGCACCTGAAGGAACTGATACCAAGAAACACTTGGACTCT	Majority
740	AGCACCTGAAGGAATTGATAGCAAGAAACACTTGGACTCT	CAT.SEQ
740	AACACCTGAAGGAATTGATAGCAAGAAACACTTGGACTCT	COW.SEQ
740	AGCATCTAAAGGAGCTGATAGCAAGAAACACTTGGACTCT	DOG.SEQ
740	AGCACCTCAAAGAACTGATCGCAAAAGACACCTGGACTCT	MOUSE.SEQ
740	AACACCTGAAGGAACTGATAGCAAGAAATACTTGGACTCT	PTSHR.SEQ
740	AGCACCTCAAAGAGCTGATCGCAAGAAACACCTGGACTCT	RAT.SEQ
740	AACACCTGAAGGAATTGATAGCAAGAAACACTTGGACTCT	SHEEP.SEQ
740	AGCACCTGAAGGAACTGATAGCAAGAAACACCTGGACTCT	HTSHR.SEQ
	AAAGAAACTTCCACTTTCCTTGAGTTTCCTTCACCTCACA	Majority
780	AAAGAAACTTCCACTTACCTTGAGTTTCCTTCACCTCACA	CAT.SEQ
780	AAGGAAACTTCCCTCTTTCCTTGAGTTTCCTTCACCTCACA	COW.SEQ
780	AAAGAAACTCCCACCTTTCCTTGAGTTTCCTTCACCTTACA	DOG.SEQ
780	CAAAAAGCTCCCGCTGTCGTTGAGTTTCCTTCACCTCACT	MOUSE.SEQ
780	AAAGAAACTTCCACTGTCCTTGAGTTTCCTTCACCTCACA	PTSHR.SEQ
780	CAAAAAGCTCCCCCTGTCCTTGAGCTTCCTTCACCTCACT	RAT.SEQ
780	AAAGAAACTTCCTCTTTCCTTGAGTTTCCTTCACCTCACA	SHEEP.SEQ
780	TAAGAAACTTCCACTTTCCTTGAGTTTCCTTCACCTCACA	HTSHR.SEQ
	CGGGCTGACCTTTCCTTATCCAAGCCACTGCTGTGCTTTTA	Majority
820	CGGGCTGACCTTTCCTTATCCAAGCCACTGCTGTGCTTTTA	CAT.SEQ
820	CGGGCTGACCTTTCCTTATCCGAGCCACTGCTGCGCTTTTA	COW.SEQ
820	CGGGCTGACCTTTCCTTATCCAAGCCACTGCTGTGCTTTTA	DOG.SEQ
820	CGGGCTGACCTCTCTTACCCGAGCCACTGCTGCGCTTTTA	MOUSE.SEQ
820	CGAGCTGACCTTTCCTTATCCAAGCCACTGCTGTGCTTTTA	PTSHR.SEQ
820	CGGGCTGACCTCTCTTACCCAAGTCACTGCTGTGCTTTTA	RAT.SEQ
820	CGGGCTGACCTTTCCTTATCCGAGCCACTGCTGTGCTTTTA	SHEEP.SEQ
820	CGGGCTGACCTTTCCTTACCCAAGCCACTGCTGTGCTTTTA	HTSHR.SEQ
	AGAATCAGAAGAAAATCAGACCAATCCTTGACTCTTTAAT	Majority
860	AGAATCAGAAGAAAATCAGAGGAATCCTTGAGTCCTTCAT	CAT.SEQ
860	AGAATCAGAAGAAAATCAGAGGAATCCTTCAGTCTTTAAT	COW.SEQ
860	AGAATCAGAAGAAAATCAGAGGAATCCTTGAGTCCTTAAT	DOG.SEQ
860	AGAACCAGAAGAAAATCAGGGGAATCCTGGAGTCTTTGAT	MOUSE.SEQ
860	AGAATCAGAAGAGATCAGAGGAATCCTTGAGTCTTTAAT	PTSHR.SEQ
860	AGAACCAGAAGAAAATCAGGGGAATCCTAGAGTCTTTGAT	RAT.SEQ
860	AGAATCAGAAGAAATATCAGAGGAATCCTTCAGTCTTTAAT	SHEEP.SEQ
860	AGAATCAGAAGAAAATCAGAGGAATCCTTGAGTCCTTGAT	HTSHR.SEQ

FIG. 4

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KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ Majority

250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ HTSHR.PRO
 250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ PTSHR.PRO
 250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ BTSHR.PRO
 250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ CTSHR.PRO
 250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ DTSHR.PRO
 250 KELIAKDTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ MTSHR.PRO
 250 KELIAKNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ RTSHR.PRO
 250 KELIARNTWTLKKLPLSLSFLHLTRADLSYPSHCCAFKNQ STSHRP.PRO

KKIRGILESLMCNESSIRSLRQRKSVNALNGPFYQEYEEED Majority

290 KKIRGILESLMCNESSMQSLRQRKSVNALNSPLHQEYEEEN HTSHR.PRO
 290 KKIRGILESLMCNESSIRSLRQRKSVNAVNGPFYQEYEEED PTSHR.PRO
 290 KKIRGILQSLMCNESSIRGLRQRKSASALNGPFYQEYEDX BTSHS.PRO
 290 KKIRGILESLMCNESSIRSLRQRKSVNALNGPFDQEYEEY CTSHR.PRO
 290 KKIRGILESLMCNESSIRSLRQRKSVNTLNGPFDQEYEEY DTSHR.PRO
 290 KKIRGILESLMCNESSIRNLRQRKSVNLRGPIYQEYEEED MTSHR.PRO
 290 KKIRGILESLMCNESSIRNLRQRKSVNVMRGPVYQEYEEG RTSHS.PRO
 290 KNIRGILQSLMCNESSIWGLRQRKSASALNGPFYQEYEEED STSHRP.PRO

LDGSSAGYKENSQFQDTHSNHYYVFFEEQEDEIIGFGQE Majority

330 LGDSIVGYKEKSKFQDTHNNAHYYVFFEEQEDEIIGFGQE HTSHR.PRO
 330 LGDTSVGNKENSQFQDTHSNHYYVFFEEQEDEIIGFGQE PTSHR.PRO
 330 LGDGSAGYKENSQFQDTHSNHYYVFFEEQEDEIIGFGQQ BTSHR.PRO
 330 LGDSHAGYKDNSQFQDTHSNHYYVFFEEQXDEILGFGQE CTSHR.PRO
 330 LGDSHAGYKDNSQFQDTHSNHYYVFFEEQEDEILGFGQE DTSHR.PRO
 330 PGDNVGVYKQNSKFQESPSNSHYYVFFEEQEDEVVGFGE MTSHR.PRO
 330 LGDNHVGKQNSKFQEGPSNSHYYVFFEEQEDEIIGFGQE RTSHR.PRO
 330 LGDGSAGYKENSQFQDTHSNHYYVFFEDQEDEIIGFGQE STSHRP.PRO

LKNPQEETLQAFDSHYDYTVCGGSEDMVCTPKSDEFNPCE Majority

370 LKNPQEETLQAFDSHYDYTVCGGSEDMVCTPKSDEFNPCE HTSHR.PRO
 370 LKNPQEETLQAFDSHYDYTVCGGSEDMVCTPKSDEFNPCE PTSHR.PRO
 370 LKNPQEETLQAFDSHYDYTVCGGSEDMVCTPKSDEFNPCE BTSHR.PRO
 370 LKNPQEETLQAFDSHYDYTVCGGNEDMVCTPKSDEFNPCE CTSHR.PRO
 370 LKNPQEETLQAFDSHYDYTVCGGNEDMVCTPKSDEFNPCE DTSHR.PRO
 370 LKNPQEETLQAFESHYDYTVCGDNEDMVCTPKSDEFNPCE MTSHR.PRO
 370 LKNPQEETLQAFDSHYDYTVCGDNEDMVCTPKSDEFNPCE RTSHR.PRO
 370 LKNPQEETLQAFDNHYDYTVCGGSEEMVCTPKSDEFNPCE STSHRP.PRO

DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP Majority

410 DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP HTSHR.PRO
 410 DIMGYRFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP PTSHR.PRO
 410 DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP BTSHR.PRO
 410 DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP CTSHR.PRO
 410 DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP DTSHR.PRO
 410 DIMGYRFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP MTSHR.PRO
 410 DIMGYKFLRIVVWFVSPMALLGNVFLVILLTSHYKLTVP RTSHR.PRO
 410 DIMGYKFLRIVVWFVSLALLGNVFLVILLTSHYKLTVP STSHRP.PRO

FIG. 5

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GGAAGTATAGCAAGAAACACTTGGACTCTAAAGAACTT	Majority
750 GGAATTGATAGCAAGAAACACTTGGACTCTAAAGAACTT	CAT.SEQ
750 GGAATTGATAGCAAGAAACACTTGGACTCTAAGGAACTT	COW.SEQ
750 GGAGCTGATAGCAAGAAACACTTGGACTCTAAAGAACTC	DOG.SEQ
750 AGAAGTATCGCAAAGACACCTGGACTCTAAAAAGCTC	MOUSE.SEQ
750 GGAAGTATAGCAAGAAATACTTGGACTCTAAAGAACTT	PTSHR.SEQ
750 AGAGCTGATCGCAAGAACACCTGGACTCTAAAAAGCTC	RAT.SEQ
750 GGAATTGATAGCAAGAAACACTTGGACTCTAAAGAACTT	SHEEP.SEQ
750 GGAAGTATAGCAAGAAACACCTGGACTCTTAAGAACTT	HTSHR.SEQ
CCACTTTCCTTGAGTTTCCTTCACCTCACACGGGCTGACC	Majority
790 CCACTTACCTTGAGTTTCCTTCACCTCACACGGGCTGACC	CAT.SEQ
790 CCTCTTTCCTTGAGTTTCCTTCACCTCACACGGGCTGACC	COW.SEQ
790 CCACTTTCCTTGAGTTTCCTTCACCTTACACGGGCTGACC	DOG.SEQ
790 CCGCTGTCGTTGAGTTTCCTCCACCTCACTCGGGCTGACC	MOUSE.SEQ
790 CCACTGTCCTTGAGTTTCCTTCACCTCACACGAGCTGACC	PTSHR.SEQ
790 CCCCTGTCCTTGAGCTTCCTCCACCTCACTCGGGCTGACC	RAT.SEQ
790 CCTCTTTCCTTGAGTTTCCTTCACCTCACACGGGCTGACC	SHEEP.SEQ
790 CCACTTTCCTTGAGTTTCCTTCACCTCACACGGGCTGACC	HTSHR.SEQ
TTTCTTATCCAAGCCACTGCTGTGCTTTTAAGAATCAGAA	Majority
830 TTTCTTATCCAAGCCACTGCTGTGCTTTTAAGAATCAGAA	CAT.SEQ
830 TTTCTTATCCGAGCCACTGCTGCGCTTTTAAGAATCAGAA	COW.SEQ
830 TTTCTTATCCAAGCCACTGCTGTGCTTTTAAGAATCAGAA	DOG.SEQ
830 TCTCTTACCCGAGCCACTGCTGCGCTTTTAAGAACCAGAA	MOUSE.SEQ
830 TTTCTTATCCAAGCCACTGCTGTGCTTTTAAGAATCAGAA	PTSHR.SEQ
830 TCTCTTACCCAGTCACTGCTGTGCTTTTAAGAACCAGAA	RAT.SEQ
830 TTTCTTATCCGAGCCACTGCTGTGCTTTTAAGAATCAGAA	SHEEP.SEQ
830 TTTCTTACCCAGCCACTGCTGTGCTTTTAAGAATCAGAA	HTSHR.SEQ
GAAATCAGAGGAATCCTTGAGTCTTTAATGTGTAATGAG	Majority
870 GAAATCAGAGGAATCCTTGAGTCTTTAATGTGTAATGAC	CAT.SEQ
870 GAAATCAGAGGAATCCTTCAGTCTTTAATGTGTAACGAG	COW.SEQ
870 GAAATCAGAGGAATCCTTGAGTCTTTAATGTGTAATGAA	DOG.SEQ
870 GAAATCAGGGGAATCCTGGAGTCTTTGATGTGTAATGAG	MOUSE.SEQ
870 GAAGATCAGAGGAATCCTTGAGTCTTTAATGTGTAATGAG	PTSHR.SEQ
870 GAAATCAGGGGAATCCTAGAGTCTTTGATGTGTAATGAG	RAT.SEQ
870 GAATATCAGAGGAATCCTTCAGTCTTTAATGTGTAACGAG	SHEEP.SEQ
870 GAAATCAGAGGAATCCTTGAGTCTTTGATGTGTAATGAG	HTSHR.SEQ
AGCAGTATTCGGAGCCTGCGTCAGAGAAAATCTGTGAATG	Majority
910 AGCAGTATTCGGAGCCTGCGTCAGAGAAAATCTGTGAATG	CAT.SEQ
910 AGCAGTATTCGGGGCCTGCGTCAGAGAAAATCCGCAAGTG	COW.SEQ
910 AGCAGTATTCGGAGCCTGCGCCAGAGAAAATCTGTGAATA	DOG.SEQ
910 AGCAGTATCCGGAACCTTCGTCAAAGGAAATCAGTGAACA	MOUSE.SEQ
910 AGCAGTATTCGGAGCCTGCGTCAGAGAAAATCTGTGAATG	PTSHR.SEQ
910 AGTAGTATCCGGAACCTGCGTCAAAGAAAGTCACTGAACG	RAT.SEQ
910 AGCAGTATTTGGGGCCTGCGTCAGAGAAAATCCGCGAGTG	SHEEP.SEQ
910 AGCAGTATGCAGAGCTTGCGCCAGAGAAAATCTGTGAATG	HTSHR.SEQ

FIG. 6

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CTTTGAATGGTCCCTTCTACCAGGAATATGAAGAGGATCT Majority

950	CTTTGAATGGTCCCTTCTGACCAGGAATATGAAGAGTATCT	CAT.SEQ
950	CTTTGAATGGTCCCTTCTACCAGGAATATGAGGATNNNCT	COW.SEQ
950	CTTTGAATGGCCCCCTTTGACCAGGAATATGAAGAGTATCT	DOG.SEQ
950	TCTTGAGGGGTCCCATCTACCAGGAATATGAAGAAGATCC	MOUSE.SEQ
950	CTGTAAATGGTCCCTTTTACCAAGAATATGAAGAGGATCT	PTSHR.SEQ
950	TCATGAGGGGTCCCGTCTACCAGGAATATGAAGAAGGTCT	RAT.SEQ
950	CTTTGAATGGTCCCTTCTACCAGGAATATGAAGAGGATCT	SHEEP.SEQ
950	CCTTGAATAGCCCCCTCCACCAGGAATATGAAGAGAATCT	HTSHR.SEQ

GGGTGACAGCAGTGTGGGTACAAGGAAAACCTCCAAGTTC Majority

990	AGGTGACAGCCATGCTGGATATAAGGACAACCTCTAAGTTC	CAT.SEQ
990	GGGTGATGGCAGTGTGGGTACAAGGAGAACTCCAAGTTC	COW.SEQ
990	GGGTGACAGCCATGCTGGGTACAAGGACAACCTCTCAGTTC	DOG.SEQ
990	GGGTGACAACAGTGTGGGTACAAACAAAACCTCCAAGTTC	MOUSE.SEQ
990	GGGCGACACGAGTGTGGGAATAAGGAAAACCTCCAAGTTC	PTSHR.SEQ
990	GGGTGACAACCATGTTGGGTACAAACAAAACCTCCAAGTTC	RAT.SEQ
990	GGGTGATGGCAGTGTGGGTACAAGGAGAACTCCAAGTTC	SHEEP.SEQ
990	GGGTGACAGCATTGTTGGGTACAAGGAAAAGTCCAAGTTC	HTSHR.SEQ

CAGGATACCCATAGCAACTCTCATTATTATGTCTTCTTTG Majority

1030	CAGGATACTCGCAGCAACTCTCATTATTATGTCTTCTTTG	CAT.SEQ
1030	CAAGATACCCAAAGCAACTCTCATTACTATGTCTTCTTTG	COW.SEQ
1030	CAGGATACCGATAGCAATTCTCATTATTATGTCTTCTTCG	DOG.SEQ
1030	CAGGAGAGCCCAAGCAACTCTCACTATTACGTCTTCTTTG	MOUSE.SEQ
1030	CAGGATACCCATAGCAACTCCCATTACTACGTCTTCTTTG	PTSHR.SEQ
1030	CAGGAGGGCCCAAGCAACTCTCACTATTACGTCTTCTTTG	RAT.SEQ
1030	CAAGATACCCACAGCAACTCTCATTACTATGTCTTCTTTG	SHEEP.SEQ
1030	CAGGATACTCATAACAACGCTCATTATTACGTCTTCTTTG	HTSHR.SEQ

AAGAACAAGAGGATGAGATCATTGGTTTTGG Majority

1070	AAGAACAANNNGACGAGATCCTTGGTTTTGG	CAT.SEQ
1070	AGGAGCAAGAAGATGAGATCATCGGTTTTGG	COW.SEQ
1070	AAGAACAAGAAGATGAGATCCTCGGTTTTGG	DOG.SEQ
1070	AAGAACAAGAGGATGAGGTCGTTGGTTTCGG	MOUSE.SEQ
1070	AAGAACAAGAGGATGAGATCATTGGTTTTGG	PTSHR.SEQ
1070	AAGAACAAGAGGACGAGATCATCGGTTTCGG	RAT.SEQ
1070	AGGATCAAGAAGATGAGATCATCGGTTTTGG	SHEEP.SEQ
1070	AAGAACAAGAGGATGAGATCATTGGTTTTGG	HTSHR.SEQ

FIG. 6CONT'D

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SHYYVFFEEQEDEIIIGFGQELKNPQEETLQAFDSHYDYTV Majority

750 AHYYVFFEEQEDEIIIGFGQELKNPQEETLQAFDSHYDYTI CAT.SEQ
 750 SHYYVFFEEQEDEIIIGFGQELKNPQEETLQAFDSHYDYTV COW.SEQ
 750 SHYYVFFEEQEDEIIIGFGQELKNPQEETLQAFDSHYDYTV DOG.SEQ
 750 SHYYVFFEEQXDEILGFGQELKNPQEETLQAFDSHYDYTV MOUSE.SEQ
 750 SHYYVFFEEQEDEILGFGQELKNPQEETLQAFDSHYDYTV PTSHR.SEQ
 750 SHYYVFFEEQEDEVVGFGQELKNPQEETLQAFESHYDYTV RAT.SEQ
 750 SHYYVFFEEQEDEIIIGFGQELKNPQEETLQAFDSHYDYTV SHEEP.SEQ
 750 SHYYVFFEDQEDEIIIGFGQELKNPQEETLQAFDNHYDYTV HTSHR.SEQ

CGGSEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL Majority

790 CGDSEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL CAT.SEQ
 790 CGGSEDMVCTPKSDEFNPCEDIMGYRFLRIVVWFVSLAL COW.SEQ
 790 CGGSEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL DOG.SEQ
 790 CGGNEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL MOUSE.SEQ
 790 CGGNEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL PTSHR.SEQ
 790 CGDNEDMVCTPKSDEFNPCEDIMGYRFLRIVVWFVSLAL RAT.SEQ
 790 CGDNEDMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSPMAL SHEEP.SEQ
 790 CGGSEEMVCTPKSDEFNPCEDIMGYKFLRIVVWFVSLAL HTSHR.SEQ

LGNVFVLVILLTSHYKLTVPFLMCNLAFADFCMGMYLLL Majority

830 LGNVFVLLILLTSHYKLNVPFLMCNLAFADFCMGMYLLL CAT.SEQ
 830 LGNVFVLVILLTSHYKLTVPFLMCNLAFADFCMGMYLLL COW.SEQ
 830 LGNVFVLVILLTSHYKLTVPFLMCNLAFADFCMGLYLLL DOG.SEQ
 830 LGNVFVLIILLTSHYKLTVPFLMCNLAFADFCMGMYLLL MOUSE.SEQ
 830 LGNVFVLIVLLTSHYKLTVPFLMCNLAFADFCMGMYLLL PTSHR.SEQ
 830 LGNIFVLLILLTSHYKLTVPFLMCNLAFADFCMGVYLLL RAT.SEQ
 830 LGNVFVLVLLTSHYKLTVPFLMCNLAFADFCMGVYLLL SHEEP.SEQ
 830 LGNVFVLVILLTSHYKLTVPFLMCNLAFADFCMGLYLLL HTSHR.SEQ

IASVDLYTHSEYYNHAIWDWQTGPGCNTAGFF Majority

870 IASVDLYTHSEYYNHAIWDWQTGPGCNTAGFF CAT.SEQ
 870 IASVDLYTQSEYYNHAIWDWQTGPGCNTAGFF COW.SEQ
 870 IASVDLYTQSEYYNHAIWDWQTGPGCNTAGFF DOG.SEQ
 870 IASVDLYTHSEYYNHAIWDWQTGPGCNAAGFF MOUSE.SEQ
 870 IASVDLYTHSEYYNHAIWDWQTGPGCNTAGFF PTSHR.SEQ
 870 IASVDLYTHSEYYNHAIWDWQTGPGCNTAGFF RAT.SEQ
 870 IASVDLYTHTEYYNHAIWDWQTGPGCNTAGFF SHEEP.SEQ
 870 IASVDLYTQSEYYNHAIWDWQTGPGCNTAGFF HTSHR.SEQ

FIG. 7

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GCCAAGAGCTCAAAAACCCCCAGGAAGAGACCCTCCAGGC Majority

700 GCCAGGAGCTTAAAAACCCACAAGAAGAGACCCTACAGGC CAT.SEQ
700 GCCAACAGCTCAAAAACCCCCAGGAGGAGACCCTGCAGGC COW.SEQ
700 GGCAGGAGCTTAAAAACCCACAGGAAGAGACCCTCCAGGC DOG.SEQ
700 GCCAAGAGCTCAAAAATCCTCAGGAAGAGACTCTCCAAGC MOUSE.SEQ
700 GCCAAGAGCTCAAAAACCCCCAGGAAGAGACCCTCCAGGC PTSHR.SEQ
700 GCCAAGAGCTCAAAAATCCTCAGGAAGAGACTCTCCAAGC RAT.SEQ
700 GCCAAGAGCTTAAAAACCCCCAGGAGGAGACCCTGCAGGC SHEEP.SEQ
700 GCCAGGAGCTCAAAAACCCCCAGGAAGAGACTCTACAAGC HTSHR.SEQ

CTTTGACAGCCATTATGACTACACCGTGTGTGCGGGGCAGT Majority

740 CTTTCGATAGCCATTATGACTACACTGTGTGTGGAGGCAAT CAT.SEQ
740 CTTTGACAGCCATTACGACTATACCGTGTGTGCGGGGCAGT COW.SEQ
740 CTTTGATAGCCATTATGACTACACTGTGTGTGGTGGCAAT DOG.SEQ
740 CTTTCGAGAGCCACTATGACTACACGGTGTGTGCGGGACAAC MOUSE.SEQ
740 CTTTGACAGCCATTACGACTACACCGTGTGTGCGGGGCAGT PTSHR.SEQ
740 CTTTCGACAGCCACTATGACTACACTGTGTGTGCGGGACAAC RAT.SEQ
740 CTTTGACAACCATTACGACTATACCGTGTGCGGGGGGAGT SHEEP.SEQ
740 TTTTGACAGCCATTATGACTACACCATATGTGGGGACAGT HTSHR.SEQ

GAGGACATGGTGTGTACCCCCAAGTCAGATCAGTTCAACC Majority

780 GAAGACATGGTGTGTACTCCCAAGTCAGATGAGTTCAACC CAT.SEQ
780 GAGGACATGGTGTGTACCCCCAAGTCGGATGAGTTCAACC COW.SEQ
780 GAAGACATGGTGTGTACTCCTAAGTCAGATGAGTTCAACC DOG.SEQ
780 GAGGACATGGTGTGTACCCCCAAGTCGGACGAGTTTAACC MOUSE.SEQ
780 GAAGACATGGTGTGCACCCCCAAGTCAGATGAGTTCAACC PTSHR.SEQ
780 GAGGACATGGTGTGTACCCCCAAGTCAGACGAGTTTAACC RAT.SEQ
780 GAGGAGATGGTGTGTACCCCCAAGTCGGATGAGTTCAACC SHEEP.SEQ
780 GAAGACATGGTGTGTACCCCCAAGTCCGATGAGTTCAACC HTSHR.SEQ

CCTGTGAAGACATCATGGGCTACAAGTTCCTGAGAATTGT Majority

820 CCTGTGAAGACATAATGGGCTACAAGTTCCTGAGAATTGT CAT.SEQ
820 CCTGTGAGGACATCATGGGCTACAAGTTCCTGAGAATCGT COW.SEQ
820 CCTGTGAAGACATAATGGGCTACAAGTTCCTGAGGATTGT DOG.SEQ
820 CCTGTGAAGATATCATGGGCTACAGGTTCTGAGAATCGT MOUSE.SEQ
820 CCTGTGAAGACATAATGGGCTACAGGTTCTGAGAATCGT PTSHR.SEQ
820 CCTGTGAAGATATCATGGGCTACAAGTTCCTGAGAATCGT RAT.SEQ
820 CCTGTGAGGACATCATGGGCTACAAGTTCCTGAGAATTGT SHEEP.SEQ
820 CGTGTGAAGACATAATGGGCTACAAGTTCCTGAGAATTGT HTSHR.SEQ

GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATGTC Majority

860 GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATGTC CAT.SEQ
860 GGTGTGGTTTGTGAGTCTGCTGGCTCTCCTGGGCAACGTC COW.SEQ
860 GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATGTC DOG.SEQ
860 GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATATC MOUSE.SEQ
860 GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATGTC PTSHR.SEQ
860 GGTATGGTTTGTAGTCTGCTGGCTCTCCTGGGCAACGTC RAT.SEQ
860 GGTGTGGTTTGTGAGTCTGCTGGCTCTCCTGGGCAACGTC SHEEP.SEQ
860 GGTGTGGTTTGTAGTCTGCTGGCTCTCCTGGGCAATGTC HTSHR.SEQ

FIG. 8

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4D7 - HC

DVQLKHSGPELVKPGASMKISCKASGYSFTGYTMNWVKQSHGKNLEWIGL
 INPYTGGTNYNQKFKGKAKLTVDKSSSTAFMELLSLTSEDSAVYYCARDG
 NLDYWGQGTTLTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPE
 PVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVA
 HPASKTKVD

FIG. 9

4D7 - HC

DVQLKHSGPELVKPGASMKISCKASGYSFT	GYTMNWVKQSHGKNLEWIGL	50
PCR primer	CDR I	
INPYTGGTNYNQKFKG	KAKLTVDKSSSTAFMELLSLTSEDSAVYYCARDG	100
CDR II	CDR III	
NLDYWGQGTTLTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPE		150
constant region		
PVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVA		200
HPASKTKVD		209
PCR primer		

FIG. 10

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4D7 - LC

SIVMSQSPASLAVSLGQRATISCRASETVDNYGFSFMHWFQQIPGQPPKL
LIYAASNQSGVPAFSGSGSGTDFSLNIHPMEEDDTAMYFCQOSKEVPY
TFGGGTKLEIKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINV
KWKIDGSERQNGVLNSWTDQDSKDYSTYSMSSTLTTLTKDEYERHNSYTCEA
THKTSTSPIVKSFNRECE

FIG. 11

4D7 - LC

SIVMSQSPASLAVSLGQRATISCRASETVDNYGFSFMHWFQQIPGQPPKL	50
PCR primer CDR I	
LIYAASNQSGVPAFSGSGSGTDFSLNIHPMEEDDTAMYFCQOSKEVPY	100
CDR II CDR III	
TFGGGTKLEIKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINV	150
constant region	
KWKIDGSERQNGVLNSWTDQDSKDYSTYSMSSTLTTLTKDEYERHNSYTCEA	200
THKTSTSPIVKSFNRECE	218
PCR primer	

FIG. 12

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16E5 - HC

DVQLVQSGPELVKPGASVKMSCKASGYSTGYNMHWVKQSHGKSLEWIGY
 IDPYNGATSYNQKFEDKATLTVDKSSSTAYMQLNSLTSEDSAVYYCARRW
 DWDPYAMDYWGQGTSTVTVSSAKTTAPSVYPLAPVCGDTSGSSVTLGCLVK
 GYFPEPVTTLTWNSGSLSSGVHTSPAVLQSDLYTLSSSVTVTSSTWPSQSI
 TCNVAHPASKTKVD

FIG. 13

16E5 - HC

DVQLVQSGPELVKPGASVKMSCKASGYST	<u>GYNMHWVKQSHGKSLEWIGY</u>	50
PCR primer	CDR I	
<u>IDPYNGATSYNQKFED</u>	KATLTVDKSSSTAYMQLNSLTSEDSAVYYCARRW	100
CDR II		
<u>DWDPYAMDY</u>	WGQGTSTVTVSSAKTTAPSVYPLAPVCGDTSGSSVTLGCLVK	150
CDR III	constant region	
GYFPEPVTTLTWNSGSLSSGVHTSPAVLQSDLYTLSSSVTVTSSTWPSQSI		200
TCNVAHPASKTKVD		214
PCR primer		

FIG. 14

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16E5 - LC

DILLTQSPAILSVSPGERVSFSCRASQSIGTSIHWWYQORTNGSPRLLIKY
 ASESISGIFSRFSGSGSGTDFTLTINSVESEDIADYYCQOSNRWPLTFGA
 GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINVWKWI
 DGSERQNGVLNSWTDQDSKDYSTYSMSSTLTTLTKDEYERHNSYTCEATHKT
 STSPIVKSFNRNEC

FIG. 15

16E5 - LC

DILLTQSPAILSVSPGERVSFSC	<u>RASQSIGTSIH</u>	WWYQORTNGSPRLLIKY	50
PCR primer	CDR I		
<u>ASESIS</u>	GIFSRFSGSGSGTDFTLTINSVESEDIADYYC	<u>QOSNRWPLT</u>	100
CDR II		CDR III	
GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINVWKWI			150
constant region			
DGSERQNGVLNSWTDQDSKDYSTYSMSSTLTTLTKDEYERHNSYTCEATHKT			200
<u>STSPIVKSFNRNEC</u>			214
PCR primer			

FIG. 16

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17D2 - HC

DVQIQQSGPELVKPGASVKMSCKASGYSTAYNMHWVKQTHGKSLEWIGY
 IDPYSGATSYHQKFKGKATLTVDKSSSTAYMRLNSLTSEDSAVYYCARRW
 DWDPTYAMDYWGQTSVTVSSAKTTPPSVYPLAPGCGDTTGSSVTLGCLVK
 GYFPESVTVTWNSGSLSSSVHTFPALLQSGLYTMSSSVTVPSSAWPSQTV
 TCSVAHPASNTTVD

FIG. 17

17D2 - HC

DVQIQQSGPELVKPGASVKMSCKASGYST	AYNMHWVKQTHGKSLEWIGY	50
PCR primer	CDR I	
IDPYSGATSYHQKFKG	KATLTVDKSSSTAYMRLNSLTSEDSAVYYCAR	100
CDR II		
DWDPTYAMDY	WGQTSVTVSSAKTTPPSVYPLAPGCGDTTGSSVTLGCLVK	150
CDR III	constant region	
GYFPESVTVTWNSGSLSSSVHTFPALLQSGLYTMSSSVTVPSSAWPSQTV		200
TCSVAHPASNTTVD		214
PCR primer		

FIG. 18

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17D2 - LC

SVEMSQSPAILSVSPGERISFSCRASQSIGTSHWYQORTNGSPRLLIKY
 ASASISGIPSRFSGSGSGTDFTLSINSVESEDIADYYCQQSNSWPLTFGA
 GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINVKWKI
 DGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEATHKT
 STSPIVKSFNRNEC

FIG. 19

17D2 - LC

SVEMSQSPAILSVSPGERISFSC	<u>RASQSIGTSHWYQORTNGSPRLLIKY</u>	50
PCR primer	CDR I	
<u>ASASIS</u> GIPSRFSGSGSGTDFTLSINSVESEDIADYYC	<u>QQSNSWPLTFGA</u>	100
CDR II	CDR III	
GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNNFYPKDINVKWKI		150
constant region		
DGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEATHKT		200
STSPIVKSFNRNEC		214
PCR primer		

FIG. 20

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14D3 - HC

DVQMQQPGPELVKPGASLKMSCKASGYSTGYNMHWVKQSHGKSLEWIGY
IDPYSGATSYNQKFEGKATLTVDKSSSTAYMQLNSLTSEDSAVYYCARRW
DWDPYAMDYWGQTSVTVSSAKTTAPSVYPLAPVCGDTSGSSVTLGCLVK
GYFPEPVTTLTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVTSSTWPSQSI
TCNVAHPASNTKVD

FIG. 21

14D3 - HC

DVQMQQPGPELVKPGASLKMSCKASGYST	GYNMHWVKQSHGKSLEWIGY	50
PCR primer	CDR I	
IDPYSGATSYNQKFEG	KATLTVDKSSSTAYMQLNSLTSEDSAVYYCAR	100
CDR II		
DWDPYAMDY	WGQTSVTVSSAKTTAPSVYPLAPVCGDTSGSSVTLGCLVK	150
CDR III	constant region	
GYFPEPVTTLTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVTSSTWPSQSI		200
TCNVAHPASNTKVD		214
PCR primer		

FIG. 22

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14D3 - LC

NILMTQSPAILSVPGERVSFACRASQSIGTSHWYQQRTNGSPRLLIK
 ASESISGIPSRFSGSGSGTDFTLSINSVESEDIADYYCQQTNRWPLTFGA
 GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNMFYPKDINVKWKI
 DGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEATHKT
 STSPIVKSFNRNEC

FIG. 23

14D3 - LC

<u>NILMTQSPAILSVPGERVSFACRASQSIGTSHWYQQRTNGSPRLLIK</u>	50
PCR primer CDR I	
<u>ASESIS</u> GIPSRFSGSGSGTDFTLSINSVESEDIADYYC <u>QQTNRWPLT</u> FGA	100
CDR II CDR III	
GTKLELKRADAAPTVSIFPPSSEQLTSGGASVVCFLNMFYPKDINVKWKI	150
constant region	
DGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEATHKT	200
<u>STSPIVKSFNRNEC</u>	214
PCR primer	

FIG. 24

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4D7 - HC

gacgtccagctgaagcactcaggacctgagctggtgaagcctggagcttc
aatgaagatatcctgtaaggcttctgggtactcattcactggctacacca
tgaactgggtgaagcagagccatggaaagaaccttgagtggattggactt
attaatccttacactggtggtactaactacaaccagaagttcaagggcaa
ggccaaattaactgtagacaagtcattccagcacagccttcattggagctcc
tcagtctgacatctgaggactctgcagtctattactgtgcaagagatggt
aaccttgactactggggccaaggcaccactctcacagtctcctcagccaa
aacgacacccccatctgtctatccactggcccctggatctgctgccaaa
ctaactccatgggtgaccctgggatgcctggtcaagggctatttcctgag
ccagtgacagtgacctggaactctggatccctgtccagcgggtgtgcacac
cttcccagctgtcctgcagtctgacctctacactctgagcagctcagtga
ctgtcccctccagcacctggcccagcgagaccgtcacctgcaacgttgcc
caccagccagcaagaccaaggtcgac

FIG. 25

20 / 52

4D7 - HC

gacgtccagctgaagcactcaggacctgagctggtgaagcctggagcttc 50
PCR primer

aatgaagatatcctgtaaggcttctggttactcattcactggctacacca 100
CDR I

tgaacttgggtgaagcagagccatggaaagaaccttgagtggattggactt 150

attaatccttacactggttggtactaactacaaccagaagtccaagggcaa 200
CDR II

ggccaaattaactgtagacaagtcacccagcacagccttcattggagctcc 250

tcagtctgacatctgaggactctgcagtctattactgtgcaagagatggt 300
CDR III

aaccttgactactggggccaaggcaccactctcacagtctcctcagccaa 350

aacgacacccccatctgtctatccactggcccttggaatctgctgcccaaa 400
constant region

ctaactccatggtgacctggtgatgctggtcaagggctatttcctgag 450

ccagtgcagtgacctggaactctggatccctgtccagcgggtgtgcacac 500

cttcccagctgtcctgcagtctgacctctacactctgagcagctcagtga 550

ctgtcccctccagcacctggcccagcgagaccgtcacctgcaacggttgcc 600

caccagccagcaagaccaaggtcgac 627
PCR primer

FIG. 26

21 / 52

4D7 - LC

agcattgtgatgtcacagtcgccagcttctttggctgtgtctctagggca
gagggccaccatctcctgcagagccagcgaaactgttgataattatggct
ttagttttatgcactgggtccaacagataccgggacagccacccaaactc
ctcatctatgctgcatccaaccaaggatccggggctccctgccaggttag
tggcagtgggctctgggacagacttcagcctcaacatccatcctatggagg
aggatgatactgcaatgtatttctgtcagcaaagtaaggagggttccgtac
acgttcggaggggggaccaagctggaaataaaaacgggctgatgctgcacc
aactgtatccatcttcccaccatccagtgagcagttaacatctggagggtg
cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc
aagtggaagattgatggcagtgaaacgacaaaatggcgtcctgaacagttg
gactgatcaggacagcaaagacagcacctacagcatgagcagcacctca
cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc
actcacaagacatcaacttcacccattgtcaagagcttcaacaggaatga
gtgt

FIG. 27

22 / 52

4D7 - LC

agcattgtgatgtcacagtcgccagcttctttggctgtgtctctagggca 50
 PCR primer

gagggccaccatctcctgcagagccagcgaactgttgataattatggct 100
 CDR I

ttagttttatgcactggttccaacagataccgggacagccacccaaactc 150

ctcatctatgctgcattccaaccaaggatccggggtcctgccaggttag 200
 CDR II

tggcagtgggtctgggacagacttcagcctcaacatccatcctatggagg 250

aggatgatactgcaatgtattttctgtcagcaaagtaaggaggttccgtac 300
 CDR III

acgttcggaggggggaccaagctggaaataaaaacgggctgatgctgcacc 350
 constant region

aactgtatccatcttcccaccatccagtgagcagttaacatctggagggtg 400

cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc 450

aagtggaagattgatggcagtgaaacgacaaaatggcgtcctgaacagttg 500

gactgatcaggacagcaaagacagcacctacagcatgagcagcacctca 550

cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc 600

actcacaagacatcaacttcacccattgtcaagaggcttcaacaggaatga 650
 PCR primer

gtgt 654

FIG. 28

23 / 52

16E5 - HC

gaogtccagttggtgcaatctggacctgagctggtgaagcctggagcttc
agtgaagatgtcctgcaaggcttctggttactcattcactggctacaaca
tgcaactgggtgaagcagagccatggaaagagccttgagtggattgggtat
attgatccttacaatggtgctactagctacaaccagaaattcgaggacaa
ggccacattgactgtagacaaatcttccagcacagcctacatgcagctca
acagcctgacatctgaggactctgcagctctattactgtgcaagaagatgg
gactgggacccttatgctatggactactggggtcaaggaacctcagtcac
cgtctcctcagccaaaacaacagcccatcggtctatccactggccctg
tgtgtggagatacaagtggctcctcggtgactctaggatgcctgggtcaag
ggttatttccctgagccagtgcacctgacctggaactctggatccctgtc
cagtggtgtgcacacctccccagctgtcctgcagctctgacctctacacc
tcagcagctcagtgactgtaacctcgagcacctggcccagccagtcctc
acctgcaatgtggcccacccggccagcaagaccaaggtcgac

FIG. 29

24 / 52

16E5 - HC

gacgtccagttggtgcaatctggacctgagctggtgaagcctggagcttc 50
PCR primer

agtgaagatgtcctgcaaggcttctggttactcattcactggctacaaca 100
CDR I

tgcacttggtgaagcagagccatggaaagagccttgagtggattgggtat 150

attgatccttacaatggtgctactagctacaaccagaaattcgaggacaa 200
CDR II

ggccacattgactgtagacaaatcttccagcacagcctacatgcagctca 250

acagcctgacatctgaggactctgcagtctattactgtgcaagaagatgg 300
CDR III

gactgggacccttatgctatggactactggggtcaaggaaacctcagtcac 350

cgtctcctcagccaaaacaacagcccccacggtctatccactggccctg 400
constant region

tgtgtggagatacaagtggctcctcggtgactctaggatgcctggtcaag 450

ggttatttccttgagccagtgaccttgacctggaactctggatccctgtc 500

cagtgggtgtgcacacctccccagctgtcctgcagtctgacctctacaccc 550

tcagcagctcagtgactgtaacctcgagcacctggcccagccagtcocatc 600

acctgcaatgtggccccaccggccagcaagaccaaggtcgac 642
PCR primer

FIG. 30

25 / 52

16E5 - LC

gacatcttgctgactcagtcctccagccatcctgtctgtgagtcaggaga
aagagtcagtttctcctgcagggccagtcagagcattggcacaagcatac
actgggtatcagcaaagaacaaatgggtctccaaggcttctcataaagtat
gcttctgagtccatctctgggatattttctagggttagtggtgagtgatc
aggacagattttactcttaccatcaacagtggtggagtctgaagatattg
cagattattactgtcaacaaagtaatagggtggccgctcacgttcggagct
gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat
cttcccaccatccagtgagcagttaacatctggagggtgcctcagtcgtgt
gcttcttgaacaacttctaccccaaagacatcaatgtcaagtggaagatt
gatggcagtgaaacgacaaaatggcgtcctgaacagttggactgatcagga
cagcaaagacagcacctacagcatgagcagcaccctcacgttgaccaagg
acgagtatgaacgacataaacagctatacctgtgaggccactcacaagaca
tcaacttcaccatttgtcaagagcttcaacaggaatgagtgt

FIG. 31

26 / 52

16E5 - LC

gacatcttgctgactcagtcctccagccatcctgtctgtgagtcaggaga 50
PCR primer

aagagtcagtttctcctgcagggccagtcagagcattggcacaagcatac 100

CDR I

actgggtatcagcaaagaacaaatggttctccaaggcttctcataaagtat 150

gcttctgagtcctctctgggatattttctaggtttagtggcagtggttc 200

CDR II

aggacagattttactcttaccatcaacagtggtggagtctgaagatattg 250

cagattattactgtcaacaaagtaataggtggccgctcacgttcggagct 300

CDR III

gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat 350
constant region

cttcccaccatccagtgagcagttaacatctggaggtgcctcagtcgtgt 400

gcttcttgaacaacttctaccccaaagacatcaatgtcaagtggaagatt 450

gatggcagtgaaacgacaaaatggcgctcctgaacagttggactgatcagga 500

cagcaaagacagcacctacagcatgagcagcaccctcacgttgaccaagg 550

acgagtatgaacgacataacagctatacctgtgaggccactcacaagaca 600

tcaacttcaccattgtcaagaggcttcaacaggaatgagtgt 642
PCR primer

FIG. 32

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17D2 - HC

gacgtccagatccagcagtcctgggcctgagctggtgaagcctggagcttc
agtgaagatgtcctgcaaggcttctggttactcattcactgcctacaaca
tgcactgggtgaagcagacccatggaaagagccttgagtggattggttat
attgatccttacagtgggtgctactagctaccaccagaaattcaagggcaa
ggccacattgactggtgacaaatcttccagcacagcctacatgcgctca
acagcctgacatctgaggactctgcagtcctattactgtgcaagaagatgg
gactgggacccttatgctatggactactggggtcaaggaacctcagtcac
cgtctcctcagccaaaacaacacccccatcagtcctatccactggccctg
ggtgtggagatacaactggttcctccgtgactctgggatgcctggtcaag
ggctacttccctgagtcagtcagtcgactgtgacttggaactctggatccctgtc
cagcagtcgtgcacaccttcccagctctcctgcagtcctggactctacacta
tgagcagtcagtcagtcgctcccctccagcgctggccaagtcagaccgtc
acctgcagcgttgctcaccgcggccagcaacaccacgggtcgac

FIG. 33

28 / 52

17D2 - HC

gacgtccagatccagcagtctgggcctgagctgggtgaagcctggagcttc 50
 PCR primer

agtgaagatgtcctgcaaggcttctgggttactcattcactgcctacaaca 100
 CDR I

tgcacttggtgaagcagacccatggaaagagccttgagtggattggttat 150

attgatccttacagtgggtgctactagctaccaccagaaattcaagggcaa 200
 CDR II

ggccacattgactgttgacaaatcttcagcacagcctacatgcgcctca 250

acagcctgacatctgaggactctgcagtctattactgtgcaagaagatgg 300

gactgggacccttatgctatggactactgggggtcaaggaacctcagtcac 350
 CDR III

cgtctcctcagccaaaacaacacccccatcagtctatccactggcccctg 400
 constant region

ggtgtggagatacaactggttcctccgtgactctgggatgcctggtcaag 450

ggctacttccctgagtcagtgactgtgacttggaactctggatccctgtc 500

cagcagtgtgcacaccttcccagctctcctgcagtctggactctacacta 550

tgagcagctcagtgactgtcccctccagcgcctggccaagtcagaccgtc 600

acctgcagcgttgetcacccggccagcaacaccacggtcgac 642
 PCR primer

FIG. 34

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17D2 - LC

agcggttgagatgtcacagtcgccagccatcctgtctgtgagtcaggaga
aagaatcagtttctcctgcagggccagtcagagcattggcacaagcatac
actggtatcagcaaagaacaaatgggttctccaaggcttctcattaagtat
gcttctgcgtctatctctgggatcccttccaggtttagtggcagtgatc
agggacagatcttactcttagcatcaacagtggtggagtctgaagatattg
cagattattactgtcaacaaagtaatagctggccgctcacgttcggtgct
gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat
cttcccaccatccagtgagcagttaacatctggagggtgcctcagtcgtgt
gcttcttgaacaacttctaccccaaagacatcaatgtcaagtgggaagatt
gatggcagtgaaacgacaaaatggcgtcctgaacagttggactgatcagga
cagcaaagacagcacctacagcatgagcagcaccctcacgttgaccaagg
acgagtatgaacgacataacagctatacctgtgaggccactcacagaca
tcaacttcacccattgtcaagagcttcaacaggaatgagtgt

FIG. 35

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17D2 - LC

agcgttgagatgtcacagtcgccagccatcctgtctgtgagtcaggaga 50
PCR primer

aagaatcagtttctcctgcagggccagtcagagcattggcacaagcatac 100
CDR I

actgggtatcagcaaagaacaaatgggttctccaaggcttctcattaagtat 150

gcttctgcgtctatctctgggatcccttcagggttagtgggcagtggatc 200
CDR II

agggacagattttactcttagcatcaacagtgtggagtctgaagatattg 250

cagattattactgtcaacaaagtaataagctggccgetcacgttcggtgct 300
CDR III

gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat 350
constant region

cttcccaccatccagtgagcagttaacatctggagggtgcctcagtcgtgt 400

gcttcttgaacaacttctaccccaaagacatcaatgtcaagtggaagatt 450

gatggcagtgaacgacaaaaatggcgctcctgaacagttggactgatcagga 500

cagcaaagacagcacctacagcatgagcagcaccctcacgttgaccaagg 550

acgagtatgaacgacataacagctatacctgtgaggccactcacaagaca 600

tcaacttcacccattgtcaagagcttcaacaggaatgagtgt 642
PCR primer

FIG. 36

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14D3 - HC

gacgtccagatgcagcagcctgggcctgagctggtgaagcctggagcttc
actaaagatgtcctgcaaggcttctggttactcattcactggctacaaca
tgcaactgggtgaagcagagccatggaaagagccttgagtggattggatat
attgatccttacagtgggtgctactagctacaaccagaaattcgagggcaa
ggccacattgactgtagacaaatcttccagcacagcctacatgcagctca
acagcctgacatctgaggactctgcagtctattactgtgcaagaagatgg
gactgggacccttatgctatggactactggggtcaaggaacctcagtcac
cgtctcctcagccaaaacaacagcccatcggtctatccactggcccctg
tgtgtggagatacaagtggctcctcggtgactctaggatgcctggtcaag
ggttatttcctgagccagtgaccttgacctggaactctggatccctgtc
cagtgggtgtgcacaccttcccagctgtcctgcagtctgacctctacacc
tcagcagctcagtgactgtaacctcgagcacctggcccagccagtcctc
acctgcaatgtggcccacccagccagcaacaccaagggtcgac

FIG. 37

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14D3 - HC

gacgtccagatgcagcagcctgggcctgagctggtgaagcctggagcttc 50
PCR primer

actaaagatgtcctgcaaggcttctggttactcattcactggctacaaca 100
CDR I

tgaactgggtgaagcagagccatggaaagagccttgagtggattggatat 150

attgataccttacagtggctgctactagctacaaccagaaattcgagggcaa 200
CDR II

ggccacattgactgtagacaaatcttcagcacagcctacatgcagctca 250

acagcctgacatctgaggactctgcagtctattactgtgcaagaagatgg 300
CDR III

gaactgggacccttatgctatggactactggggtcaaggaacctcagtcac 350

cgtctcctcagccaaaacaacagcccatcggtctatccactggccctg 400
constant

tgtgtggagatacaagtggctcctcggtgactctaggatgcctgggtcaag 450

ggttatttccttgagccagtgaccttgacctggaactctggatccctgtc 500

cagtgggtgtgcacaccttcccagctgtcctgcagtctgacctctacacc 550

tcagcagctcagtgactgtaacctcgagcacctggcccagccagtcctac 600

acctgcaatgtggcccacccagccagcaacaccaagggtcgac 642
PCR primer

FIG. 38

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14D3 - LC

aacattctgatgacacagtctccagccatcttgtctgtgagtcaggaga
aagagtcagtttcgcctgcagggccagtcagagcattggcacaagcatac
actggtatcagcaaagaacaaatggttctccaaggcttctcataaagtat
gcttctgagtctatctctgggatcccttccaggtttagtggcagtggtc
agggacagattttactcttagcatcaacagtggtggagtctgaagatattg
cagattattactgtcaacaaactaataggtggccgctcacgttcggtgct
gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat
cttcccaccatccagtgagcagttaacatctggaggtgcctcagtcgtgt
gcttcttgaacaacttctaccccaaagacatcaatgtcaagtggaagatt
gatggcagtgaaacgacaaaatggcgctcctgaacagttggactgatcagga
cagcaaagacagcacctacagcatgagcagcacccctcacgttgaccaagg
acgagtatgaacgacataacagctatacctgtgaggccactcacaagaca
tcaacttcacccattgtcaagagcttcaacaggaatgagtg

FIG. 39

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14D3 - LC

aacattctgatgacacagtctccagccatcttgtctgtgagtccaggaga 50
PCR primer

aagagtcagtttcgcctgcagggccagtcagagcattggcacaagcatac 100
CDR I

actgggtatcagcaaagaacaaatgggttctccaaggcttctcataaagtat 150

gcttcgagtcctatctcgggatcccttcaggtttagtggcagtggtac 200
CDR II

agggacagattttactcttagcatcaacagtgtggagtctgaagatattg 250

cagattattactgtcaacaaactaataggcggccgctcaggttcggtgct 300
CDR III

gggaccaagctggagctgaaacgggctgatgctgcaccaactgtatccat 350
constant region

cttcccaccatccagtgagcagtttaacatctggaggtgcctcagtcgtgt 400

gcttcttgaacaacttctaccccaaagacatcaatgtcaagtggaagatt 450

gatggcagtgaaacgacaaaatggcgctcctgaacagttggactgatcagga 500

cagcaaagacagcacctacagcatgagcagcaccctcacgttgaccaagg 550

acgagtatgaacgacataacagctatacctgtgaggccactcacaagaca 600

tcaacttcacccattgtcaagagcttcaacaggaatgagtggt 642
PCR primer

FIG. 40

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3B3 - HC

DVQLQQPGAELVKPGASVKLSCTTSGVNIKDTYMHWMKQRPEQGLEWIGR
 IDPANGNTKYDPKFRGKATITADTSSNTVYVQLRSLTSEDVAVYYCAYDG
 YWGQGTLLTVSAAKTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPEPVT
 VTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVVHPA
 SSTKVD

FIG. 41

3B3 - HC

DVQLQQPGAELVKPGASVKLSCTTSGVNIKDTYMHWMKQRPEQGLEWIGR 50
 PCR primer CDR I
 IDPANGNTKYDPKFRGKATITADTSSNTVYVQLRSLTSEDVAVYYCAYDG 100
 CDR II CDR III
 YWGQGTLLTVSAAKTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPEPVT 150
 constant region
 VTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVVHPA200
 PCR primer
 SSTKVD 206

FIG. 42

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3B3 - LC

NIVMTQTPASLAVSLGQRATISCRASESVDSYGNNFMHWYQQKPGQSPRL
LIYRASNL~~ES~~GIPARFSGSGSRTDFTLTNPVEADDVATYYCQQSHKDPL
TFGAGTKLELKRADAAPT~~VS~~IFPPSSEQLTSGGASVVCFLNNFYPKDINV
KWKIDG~~SERQ~~NGVLNSWTDQDSKSTYSMSSTLT~~LT~~TKDEYERHNSYTCEA
THKTSTSPIVKSFKANEC

FIG. 43

3B3 - LC

NIVMTQTPASLAVSLGQRATISCRASESVDSYGNNFMHWYQQKPGQSPRL	50
PCR primer CDR I	
LIYRASNL ES GIPARFSGSGSRTDFTLTNPVEADDVATYYCQQSHKDPL	100
CDR II CDR III	
TF FGAGTKLELKRADAAPT VS IFPPSSEQLTSGGASVVCFLNNFYPKDINV	150
constant region	
KWKIDG SERQ NGVLNSWTDQDSKSTYSMSSTLT LT TKDEYERHNSYTCEA	200
THKTSTSPIVKSFKANEC	218
PCR primer	

FIG. 44

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3C7 - HC

DVQLKHSGPELVKPGASKISKASGYSFTGYTMNWVKQSHGKNLDWIGL
 INPYNGGTSYDQKFKGKATLTVDKSSSTAYMELLSLTSEDSAVYYCARDG
 LMDYWGQGTSVTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPE
 PVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVA
 HPASKTKVD

FIG. 45

3C7 - HC

DVOLKHSGPELVKPGASKISKASGYSFT	GYTMNWVKQSHGKNLDWIGL	50
PCR primer	CDR I	
INPYNGGTSYDQKFKG	KATLTVDKSSSTAYMELLSLTSEDSAVYYCARDG	100
CDR II		
LMDYWGQGTSVTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCLVKGYFPE		150
CDR III	constant region	
PVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSETVTCNVA		200
HPASKTKVD		209
PCR primer		

FIG. 46

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3C7 - LC

DIVMTQTPASLAVSLGQRATIFCRASQSVDYNGISYMHWFQOKPGQPPKL
 LIYAASNLESGIPARFSGSGSGTDFTLNHPVEEEDAATYYCQOSFEDPH
 TFGGGTKLEIKRADAAPTVSIFFPSSEQLTSGGASVVCFLNNFYPKDINV
 KWKIDGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEA
 THKTSTSPIVKSFNRNEC

FIG. 47

3C7 - LC

DIVMTQTPASLAVSLGQRATIFCRASQSVDYNGISYMHWFQOKPGQPPKL	50
PCR primer CDR I	
LIYAASNLESGIPARFSGSGSGTDFTLNHPVEEEDAATYYCQOSFEDPH	100
CDR II CDR III	
TFGGGTKLEIKRADAAPTVSIFFPSSEQLTSGGASVVCFLNNFYPKDINV	150
constant region	
KWKIDGSERQNGVLNSWTDQDSKDYMSSTLTTLTKDEYERHNSYTCEA	200
THKTSTSPIVKSFNRNEC	218
PCR primer	

FIG. 48

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2B4 - HC

DVQLQQSGTVLARPGASVRMSCKASGYSFTRYWIHWLKQRPGQGLEWIGA
 IFPGNRDTSYNQRFKGAEVTAVTSASTAYLDLSSLTNEDSAVYYCTRWP
 YYGSIYVNFYWGQGTTLTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCL
 VKGYFPEPVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSE
 TVTCNVAHPASSTKVD

FIG. 49

2B4 - HC

DVQLQQSGTVLARPGASVRMSCKASGYSFTRYWIHWLKQRPGQGLEWIGA	50
PCR primer	CDR I
IFPGNRDTSYNQRFKGAEVTAVTSASTAYLDLSSLTNEDSAVYYCTRWP	100
CDR II	
YYGSIYVNFYWGQGTTLTVSSAKTTPPSVYPLAPGSAAQTNSMVTLGCL	150
CDR III	constant region
VKGYFPEPVTVTWNSGSLSSGVHTFPAVLQSDLYTLSSSVTVPSSTWPSE	200
TVTCNVAHPASSTKVD	216
PCR primer	

FIG. 50

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2B4 - LC

DIVMTQSPLSLPVSLGDQASISCRTSQNLVHRNGNTYLHWYLQKPGQSPK
 LLIYKISNRFSGVPDRFSGSGSGTDFTLKISRVEAEDLGVYFCSQGTHVP
 PTFGGGTKLEIKRADAAPTVSIFFPSSEQLTSGGASVVCFLNNFYPKDIN
 VKWKIDGSERQNGVLNSWTDQDSKSTYSMSSTLTTLTKDEYERHNSYTCE
 ATHKTSTSPIVKSFNRECE

FIG. 51

2B4 - LC

DIVMTQSPLSLPVSLGDQASISCR	TSQNLVHRNGNTYLHWYLQKPGQSPK	50
PCR primer	CDR I	
LLIYKISNRFSGVPDRFSGSGSGTDFT	LKISRVEAEDLGVYFC	100
	CDR II	CDR III
PTFGGGGTKLEIKRADAAPTVSIFFPSSEQLTSGGASVVCFLNNFYPKDIN		150
	constant region	
VKWKIDGSERQNGVLNSWTDQDSKSTYSMSSTLTTLTKDEYERHNSYTCE		200
ATHKTSTSPIVKSFNRECE		219
PCR primer		

FIG. 52

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3B3 - HC

gacgtccagctccagcagcctggagcagagcttgtgaagccaggggcctc
agtcaagttgtcctgcaccacttctggcgtcaacattaaagacacctata
tgcactggatgaagcagaggcctgaacagggcctggagtggattggaagg
attgatcctgcgaatggtaataactaaatatgacccgaaattccggggcaa
ggccactataacagcagacacatcctccaacacgggtctacgtgcaactca
gaagcctgacatctgaggacactgccgtctattactgtgcctatgatggg
tactggggccaagggaactctgggcactgtctctgcagccaaaacgacacc
cccatctgtctatccactggccccctggatctgctgccccaaactaactcca
tggtgaccctgggatgcctgggtcaagggtatcttccctgagccagtgaca
gtgacctggaactctggatccctgtccagcgggtgtgcacaccttcccagc
tgtcctgcagtctgacctctacactctgagcagctcagtgactgtcccct
ccagcacctggcccagcgagaccgtcacctgcaacggtgccccacccggcc
agcagcaccaagggtcgac

FIG. 53

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3B3 - HC

gacgtccagctccagcagcctggagcagagcttgtgaagccaggggcctc 50
 PCR primer
 agtcaagttgtcctgcaccacttctggcgtcaacattaaagacacctata 100
 CDR I
 tgcactggatgaagcagaggcctgaacagggcctggagtggattggaagg 150
 attgatcctgagaatggtaataactaaatatgacccgaaattccgggggaa 200
 CDR II
 ggccactataacagcagacacatcctccaacacgggtctacgtgcaactca 250
 gaagcctgacatctgaggacactgccgtctattactgtgcctatgatggg 300
 CDR III
 tactggggccaagggaactctgggtcactgtctctgcagccaaaacgacacc 350
 constant region
 cccatctgtctatccactggccccctggatctgctgccc aaactcca 400
 tggtgaccctgggatgcctgggtcaagggtatttcctgagccagtgaca 450
 gtgacctggaactctggatccctgtccagcgggtgtgcacaccttcccagc 500
 tgtcctgcagtctgacctctacactctgagcagctcagtgactgtcccct 550
 ccagcacctggcccagcgagaccgtcacctgcaacgttgcccacccggccc 600
 PCR primer
 agcagcaccaaggtcgac 618

FIG. 54

3B3 - LC

aacattgtgatgacccaaactccagcctctttggctgtgtctctagggca
gagggccaccaatcctgcagagccagtgaagtggtgatagttatggca
ataattttatgcactggtaccagcagaaaccaggacagtcacccagactc
ctcatctatcgtgcatccaacctagaatctgggatccctgccagggttcag
tggcagtggtctaggacagacttcacctcaccactaatcctgtggagg
ctgatgatgttgcaacctattactgtcagcaaagtcataaggatccgctc
acgttcggtgctgggaccaagctggagctgaaacgggctgatgctgcacc
aactgtatccatcttcccaccatccagtgagcagttaacatctggagggtg
cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc
aagtggaagattgatggcagtgaaacgacaaaatggcgtcctgaacagttg
gactgatcaggacagcaaagacagcacctacagcatgagcagcacctca
cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc
actcacaagacatcaacttcacccattgtcaagagcttcaaggaacatga
gtgt

FIG. 55

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3B3 - LC

aacattgtgatgacccaaactccagcctctttggctgtgtctctagggca 50
PCR primer

gagggccaccatatcctgcagagccagtgaaagtgttgatagt-tatggca 100

CDR I

ataattttatgcacttggtaccagcagaaaccaggacagtcacccagactc 150

ctcatctatcgtgcattccaacctagaatctgggatccctgccagggttcag 200

CDR II

tggcagtgggtctaggacagacttcaccctcaccactaatcctgtggagg 250

ctgatgatgttgcaacctattactgtcagcaagtcataaggatcctgctc 300

CDR III

acgttcgggtgctgggaccaagctggagctgaaacgggctgatgctgcacc 350
constant region

aactgtatccatcttcccaccatccagtgagcaggttaacatctggagggtg 400

cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc 450

aagtggaagattgatggcagtgaaacgacaaaatggcgctcctgaacagttg 500

gactgatcaggacagcaaagacagcacctacagcatgagcagcacccctca 550

cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc 600

actcacaagacatcaacttcacccattgtcaagagccttcaacaggaatga 650
PCR primer

gtgt 652

FIG. 56

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3C7 - HC

gacgtccagctgaagcatcaggacctgagctggtgaagcctggagcttca
atgaagatatcctgcaaggcttctggttactcattcactggctacaccat
gaactgggtgaagcagagccatggaaagaaccttgagtggattggactta
ttaatccttacaatggtggtactagctacgaccagaagttcaagggcaag
gccacattaactgtagacaagtcacccagcacagcctacatggagctcct
cagtctgacatctgaggactctgcagtctattactgtgcaagagatggcc
tgatggactactggggtcaaggaaacctcagtcaccgtctcctcagccaaa
acgacacccccatctgtctatccactggccccctggatctgctgccccaaac
taactccatggtgacctgggatgcctggtcaagggctatttccttgagc
cagtgacagtgacctggaactctggatccctgtccagcgggtgtgcacacc
ttcccagctgtcctgcagtctgacctctacactctgagcagctcagtgc
tgtccctccagcacctggcccagcgagaccgtcacctgcaacgttgccc
acccggccagcaagaccaaggtcgac

FIG. 57

46 / 52

3C7 - HC

gacgtccagctgaagcatcaggacctgagctggtgaagcctggagcttca 50
 PCR primer
 atgaagatatcctgcaaggcttctggttactcattcactggctacacccat 100
 CDR I
gaactgggtgaagcagagccatggaaagaaccttgagtggattggactta 150
 CDR II
ttaatccttacaatggtggtactagctacgaccagaagtccaagg 200
 gccacattaactgtagacaagtcattccagcacagcctacatggagctcct 250
 cagtctgacatctgaggactctgcagtctattactgtgcaagagatggcc 300
 CDR III
tgatggactactggggtcaaggaacctcagtcaccgtctcctcagccaaa 350
 constant region
 acgacacccccatctgtctatccactggcccttgatctgctgccc aaac 400
 taactccatgggtgacctgggatgcctggtcaagggtatttccttgagc 450
 cagtgcagtgacctggaactctggatccctgtccagcgggtgtgcacacc 500
 ttcccagctgtcctgcagtctgacctctacactctgagcagctcagtgac 550
 tgteccctccagcacctggcccagcgagaccgtcacctgcaacgttgccc 600
acccggccagcaagaccaaggtcgac 626
 PCR primer

FIG. 58

47 / 52

3C7 - LC

gatattgtgatgacccaaactccagcttcttttggctgtgtctctaggaca
gagagccactatcttctgcagagccagccagagtgtcgattataatggaa
ttagttatatgcactgggttccaacagaaaccaggacagccacccaaactc
ctcatctatgctgcatccaacctagaatctgggatccctgccagggttcag
tggcagtgggtctgggacagacttcaccctcaacatccatcctgtggagg
aggaagatgctgcaacctattactgtcagcaaagtcttgaggatccgcac
acgttcggaggggggaccaagctggaaataaaaacgggctgatgctgcacc
aactgtatccatcttcccaccatccagtgagcagttaacatctggagggtg
cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc
aagtggaagattgatggcagtgaacgacaaaatggcgtcctgaacagttg
gactgatcaggacagcaaagacagcacctacagcatgagcagcacctca
cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc
actcacaagacatcaacttcacccattgtcaagagcttcaacaggaatga
gtgt

FIG. 59

48 / 52

3C7 - LC

gatattgtgatgacccaaactccagcttctttggctgtgtctctaggaca 50
PCR primer

gagagccactatcttctgcagagccagccagagtgtcgattataatggaa 100
CDR I

ttagttatatgcacttggttccaacagaaaccaggacagccacccaaactc 150

ctcatctatgctgcacccaacctagaatctgggatccctgccaggttcag 200
CDR II

tggcagtgggtctgggacagacttcaccctcaacatccatcctgtggagg 250

aggaagatgctgcaacctattactgtcagcaagttttgaggatccgcac 300
CDR III

acgttcggagggggggaccaagctggaaataaaaacgggctgatgctgcacc 350
constant region

aactgtatccatcttcccaccatccagtgagcagttaacatctggagggtg 400

cctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaatgtc 450

aagtggaagattgatggcagtgaacgacaaaatggcgtcctgaacagttg 500

gactgatcaggacagcaaagacagcacctacagcatgagcagcaccctca 550

cgttgaccaaggacgagtatgaacgacataacagctatacctgtgaggcc 600

actcacaagacatcaacttcacccattgtcaagagcttcaacaggaatga 650
PCR primer

gtgt 654

FIG. 60

2B4 - HC

gacgtccagctgcagcagctctgggactgtgctggcaaggcctggggcttc
cgtgaggatgtcctgcaaggcttctggctacagctttaccaggtactgga
tacactgggttaaaacagaggcctggacaggggtctagaatggattggtgct
atctttcctggaaatcgtgataccagttacaaccagaggttcaagggcaa
ggccgaagtgactgcagtcacatccgccagcactgcctacttggacctca
gtagcctgacaaatgaggactctgcggtctattactgtacaagatggcct
tactatgggtccatctacgttaactttgactactggggccaaggcaccac
tctcacagtctcctcagccaaaacgacacccccatctgtctatccactgg
cccctggatctgctgccc aaactaactccatgggtgaccctgggatgcctg
gtcaagggctatctccctgagccagtgacagtgacctggaactctggatc
cctgtccagcgggtgtgcacaccttcccagctgtcctgcagtcctgacctct
acactctgagcagctcagtgactgtcccctccagcacctggcccagcgag
accgtcacctgcaacgttgcccacccagccagcagcaccaaggtcgac

FIG. 61

50 / 52

2B4 - HC

gacgtccagctgcagcagtcctgggactgtgctggcaaggcctggggcttc 50
PCR primer

cgtgaggatgtcctgcaaggccttctggctacagctttaccaggtactgga 100
CDR I

tacacttggttaaaacagaggcctggacagggtctagaatggattgggtgct 150

atttttctctggaaatcgtgataccagttacaaccagagggtcaagggc 200
CDR II

ggccgaagtgactgcagtcacatccgccagcactgcctacttggacctca 250

gtagcctgacaaatgaggactctgcggtctattactgtacaagatgccct 300

tactatgggttccatctacgttaactttgactacttgggggccaaggcaccac 350
CDR III

tetcacagtctcctcagccaaaacgacacccccatctgtctatccactgg 400
constant region

cccctggatctgctgcccaaactaactccatgggtgacctgggatgcctg 450

gtcaagggctatttccttgagccagtgacagtgacctggaactctggatc 500

cctgtccagcggtgtgacaccttcccagctgtcctgcagtctgacctct 550

acactctgagcagctcagtgactgtcccctccagcacctggcccagcgag 600

accgtcacctgcaacgttgcccacccagccagcagcaccaaggtcgac 648
PCR primer

FIG. 62

2B4 - LC

gatattgtgatgaccagtcctcctctcctgcctgtcagtccttggaga
tcaagcctccatctcttgacagaactagtcagaaccttgtacacaggaatg
gaaacacctaatttacattggtacctgcagaagccaggccagtcctcaaag
ctcctgatttacaaaatttccaaccgattttctgggggtcccagacaggtt
cagtggcagtggtcagggacagatttcacactcaagatcagcagagtgg
aggctgaggatctgggagtttatttctgctctcaaggtaacacatgttcct
ccgacgttcggtggaggcaccaagctggaaatcaaaccgggctgatgctgc
accaactgtatccatcttcccaccatccagtgagcagttaacatctggag
gtgcctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaat
gtcaagtggaagattgatggcagtgaaacgacaaaatggcgtcctgaacag
ttggactgatcaggacagcaaagacagcacctacagcatgagcagcaccc
tcacgttgaccaaggacgagtatgaacgacataacagctatacctgtgag
gccactcacaagacatcaacttcacccattgtcaagagcttcaacaggaa
tgagtgt

FIG. 63

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2B4 - LC

gatattgtgatgacccagtctcctctctccctgcctgtcagtcttggaga 50
PCR primer

tcaagcctccatctcttgcagaactagtcagaaccttgtagacaggaatg 100
CDR I

gaacacacatattacattggtacctgcagaagccaggccagtctccaaag 150

ctcctgatttacaaaatttccaaccgatcttctggggtcccagacagggtt 200
CDR II

cagtggcagtggatcaggacagatttcacactcaagatcagcagagtgg 250

aggctgaggatctgggagtttattttctgctctcaaggtagacatgttct 300
CDR III

ccgacgttcgggtggaggcaccaagctggaaatcaaacgggctgatgctgc 350
constant region

accaactgtatccatcttcccaccatccagtgagcagttaacatctggag 400

gtgcctcagtcgtgtgcttcttgaacaacttctaccccaaagacatcaat 450

gtcaagtggaagattgatggcagtgaacgacaaaatggcgctcctgaacag 500

ttggactgatcaggacagcaaagacagcacctacagcatgagcagcacc 550

tcacgttgaccaaggacgagtatgaacgacataacagctatacctgtgag 600

gccactcacaagacatcaacttcacccattgtcaagagcttcaacaggaa 650
PCR primer

tgagtgt 657

FIG. 64